

SONORAN QUARTERLY

FOR MEMBERS AND FRIENDS OF THE DESERT BOTANICAL GARDEN

PHOENIX, ARIZONA MARCH 2014, VOLUME 68, NO. 1



Celebrate the Past. Shape the Future.



We need to make sure that the work we do today in pursuit of the Garden's mission will stand the test of time in 2039.

It seems like just yesterday that I wrote to you to announce the Garden's 75th Anniversary. But it was actually a year ago, in this column, that I first told Garden members and friends about this important milestone.

In the twelve months since then, we have retold the story of our founding, chronicled the Garden's expansion from 1939 until today, reincarnated (through the magic of theatre) Gertrude Divine Webster, and completely revised and printed the second edition of our history book, *Oasis in the City: The History of the Desert Botanical Garden*. As if all of this were not enough, we also hosted an anniversary party on February 13th that, I think, would have made our founders very, very proud of what their Garden has become.

On February 14th, there was a different mood in the air. Having spent a year celebrating our past, we knew it was time to shift gears. After all, there is another anniversary coming—our centennial—and we need to make sure that the work we do today in pursuit of the Garden's mission will stand the test of time in 2039. To that end, you will see many changes taking place at the Garden in the next couple of months!



Soon after the *Chihuly in the Garden* exhibition closes in May, we will begin construction on two major new exhibits along the Garden's *Desert Discovery Trail: The Desert Terrace Gardens* and *The Lewis Desert Portal*. Both exhibits will offer dramatic presentations of our priceless collection of cacti and other succulent plants, and will open in late 2014. Behind the scenes, we will spend the summer months developing plans for the Heritage Garden (to be built in 2015) our new Horticulture Center (to open in 2016) and the future Children and Family Garden (likely to be built in 2017-22.)

As has been true since the day the Garden was founded, such progress would not be possible without the support of so many members and friends of the Garden. I would like to take this occasion—as we simultaneously celebrate our past and shape our future—to thank each of you for your generosity in caring for the Desert Botanical Garden.

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The Dr. William Huizingh Executive Director

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Dale Chihuly, *Summer Sun* (detail),
2010, 15 x 14 x 14'
Desert Botanical Garden, Phoenix AZ
Installed 2013

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SOUTH AFRICAN RESEARCH ROUNDBOUT

by Dr. Joe McAuliffe, Director of Research,
Conservation, and Collections



The Gannabos quiver tree north of Nieuwoudtville.

I have long dreamed of traveling to South Africa to compare the arid environments there with those I've studied here in the southwestern United States. Those dreams came true in the fall of 2012 when I spent seven weeks in South Africa as part of a research sabbatical leave, joined by Matthew King, research assistant in my department. Planning for the trip began nearly two years earlier when I contacted Dr. Timm Hoffman, of the University of Cape Town, who I first met in 1991 when he visited the Desert Botanical Garden. Together we planned the details of the research trip to South Africa.

Botanical Wonders of Namaqualand

As an introduction to South Africa, Timm scheduled a several-day trip to a site 250 miles north of Cape Town in a desert region called Namaqualand, a hotspot of plant biodiversity. He had data to collect on a variety of plant species at one site, where I closely followed him with notebook in hand, striving to absorb all the knowledge I could. Within the first half hour, I filled four pages with over 30 scientific and common names (both English and Afrikaans) of perennial plants.

Some names were familiar, members of the same genera that also occur in the American Southwest – *Lycium* and *Rhus*, for example. However, many were plants with small succulent leaves in the family *Aizoaceae*, with most species in that family endemic to arid and semiarid parts of southern Africa. This is the same family that contains the “ice plants” widely used as ornamentals, an unwelcome nonnative species in some coastal habitats of California. One of the common flower colors of many members of this family is an intense, deep fuchsia. Landscapes painted with this vivid color gave parts of Namaqualand a vibrant visual character unlike anything I've seen before.

Among all the plants of Namaqualand, the quiver tree, *Aloe dichotoma*, wins the plant charisma contest. Timm took us to two grand quiver tree forests and those landscapes dotted with



Fushia-colored Aizoaceae in Namaqualand.



University of Cape Town at the base of Devil's Peak and Tabletop Mountain.



Matt King on giant, conical termite mound northeast of Vanrhysdorp.

the giant aloes were among the most awe-inspiring vistas we saw. In some ways these forests reminded me of certain Mojave Desert landscapes dotted with Joshua trees, with intervening areas between the widely spaced trees occupied by low shrubs and perennial bunch grasses.

Five days in Namaqualand with Timm gave us an unparalleled introduction to the landscapes, plants, and people of the region. The rest of our time in South Africa included two more long fieldtrips, punctuated by brief stays at our home base at the University of Cape Town. Each day on our walk into campus, we delighted in the sweeping views of the majestic campus with its stately, classic buildings set against the backdrop of Devil's Peak and Tabletop Mountain. The mild Mediterranean climate of Cape Town is a gardener's paradise. Streets, lanes, and sidewalks are lined with an amazing horticultural diversity including different kinds of bird-of-paradise plants, calla lilies, and other South African natives, together with European oaks, palms, and an array of plants from different parts of the globe.

The University of Cape Town is a vibrant institution, bustling with students and top-notch faculty. Within that stimulating academic environment, I had the opportunity to present an

hour-long departmental seminar on my research. I also had the honor of delivering the keynote presentation at the opening of the annual Arid Zone Ecology Conference held in the nearby town of Worcester.

Of Mounds and Termites

The purpose of the South Africa trip was, of course, about more than botanical sightseeing. One important objective was to bring my research expertise to bear on some ecological research problems in a new, unfamiliar place, with the intention of expanding the realm of knowledge. This is the challenge to every scientist, and indeed, any scientist's *raison d'être*.

In the year leading up to the trip, I spent much time remotely examining arid landscapes of western South Africa using Google Earth™. As I zoomed into views of the terrain and vegetation, I became fascinated by regularly spaced, light-colored features, typically separated by distances of 150 feet (50 m) or so. Eventually I realized that the spots were associated with some sort of mound-building termites. I launched myself into reading and learning everything I could about the biology and ecology of termites that build giant, above-ground mounds in Africa. The lure of pursuing unanswered questions about these mounds was irresistible.



Middle school students on AZEF fieldtrip with, l to r, McFadden, McAuliffe, and King. Photo by Clement Cupido, Director of Karoo Desert National Botanical Garden, Worcester, South Africa.

I was particularly fascinated with literature on a peculiar landform known in South Africa as a *heuweltjie* (Afrikaans for "little hill," pronounced *hue-vil-key*). Heuweltjies are broad earthen mounds, up to about 100 feet (30 m) wide and 6 feet (2 m) high at the center. In some places, a quarter of the land surface is covered with these regularly spaced mounds. Although they have been commonly associated with a termite species called the southern harvester termite (*Microhodotermes viator*), there is considerable scientific controversy on how the mounds form.

Some researchers believe that this termite species actively constructs mounds. Another scientist suggested that the mounds were formed long ago during the Pleistocene epoch

(the last ice age) by a species of termite no longer present, and that the mounds therefore represent fossil landscape features. The most recent research paper, published just before we departed for South Africa, concluded that termites had nothing at all to do with mound formation. Rather, authors of that paper suggested that the mounds represent patches of an ancient (Pleistocene) land surface on which regularly spaced shrub clumps grew long ago, protecting those spots from erosion while water eroded and lowered the surrounding areas over time.

A Multidisciplinary Research Team Digs In

Dr. Les McFadden of the University of New Mexico has been a colleague of mine for the last 25 years. He has helped me to understand the development of desert landforms and soils, which has contributed greatly to my ecological research. We know, for instance, that certain soil characteristics change predictably over time. As we study those characteristics, they provide information about landscape changes that have occurred over thousands of years or more.

Differences in the characteristics of the heuweltjies had already been noted. For example, some have thick, concrete-like accumulations of calcium carbonate or “caliche” (in South Africa it is called “calcrete”) not far below the surface. The calcrete has been recognized by some researchers as evidence that the mounds had originally formed long ago during the Pleistocene era. What had been previously missed, however, was how young some of the heuweltjies were, as evidenced by the lack of any significant development of soil profile characteristics.

Les McFadden joined us in making detailed comparisons of the soils of heuweltjies in one region as we sought to develop new information on the ages of these peculiar mounds and the processes by which they form. We spent two weeks together investigating questions revolving around

vegetation, termite activity, and soils. Combining the knowledge, experience, and research approaches of our different scientific disciplines was essential for the research at hand.

Clues and Experience Converge

Timm, Les, Matt and I pursued our fieldwork at multiple locations ranging from the driest part of South Africa’s interior to more moist areas. The driest place, receiving an average of only about an inch (2-3 cm) of rainfall a year, was largely covered with barren desert pavements, devoid of any plant life. In many ways, it was much like some of the desert pavements covered with rock varnish in the driest parts of the Sonoran Desert near Yuma, Arizona.

The last day of our planned research was at the crucial site where we had earlier observed a pair of heuweltjies that were very different from each other in terms of their soils. With shovels in hand, we made fresh vertical excavations into the road cut exposures of two separate mounds, carefully recording our field observations while taking samples for later laboratory analyses.

Describing the vertical sequence of soil characteristics from the surface downward is painstaking work. It involves the identification of distinct layers, or *soil horizons*, and their characteristics including thickness, nature of upper and lower boundaries, color, texture, and presence of calcium carbonate, as revealed by applying a few drops of hydrochloric acid. The samples that we had taken from each horizon were analyzed in the laboratory for texture, calcium carbonate, and salt contents.

Our work confirmed that the two mounds differed greatly in age. The one with thick, cemented calcrete had to represent a very old mound; studies from similar mounds have established, through carbon-14 analyses of carbon in the calcrete, that they can have ages exceeding 35,000 years. In contrast, the neighboring mound consisted largely of a big, rounded pile of relatively unmodified sand, apparently transported and deposited by the wind. A sandy mound such as this is quite similar to those that form beneath plant canopies in the Mojave Desert that trap wind-borne sand and other particles (see *Ancient Creosote Bush Clones: A Trail of Multidisciplinary Discoveries*, *The Sonoran Quarterly*, Volume 60, No. 4, December 2006 or available at dbg.org/sqonline).

The site is located relatively close to the Atlantic Coast where immense sheets of wind-borne sand are found stretching inland from the coast for dozens of miles in some places. The entire valley that we studied, along with its surrounding low-lying hills, was covered with

McFadden examining soil profile (upper), Cross-section of a large heuweltjie (lower).





Dense cover of pink-flowering *Mesembryanthemum juncea* on heuweltjie south of Laingsburg.

deposits of wind-borne sand. We posited that the heuweltjies were localized accumulations of these wind-borne materials. The question remained as to why sand transported by wind would accumulate in regularly spaced mounds rather than be distributed more uniformly or perhaps in some other less regular pattern.

This is where further observations of plants and an abundance of existing knowledge about the effects of termites on soils were brought together to supply a new explanation for how heuweltjies form.

A New Conclusion

Harvester termites cut and gather small pieces of living vegetation like leaves and small stems, bringing these materials back to their underground nests. These materials are stored in small chambers underground and are eventually consumed. Over time, this harvesting and transport of materials to the mounds concentrates the nutrients and minerals within soils around the centralized nest. Several other studies have confirmed that the soils of heuweltjies are substantially enriched in plant nutrients compared to the surrounding soils.

Previous studies and our own work have shown that heuweltjies frequently possess taller and denser vegetation than in surrounding areas and that

the plant species that occupy heuweltjies are typically also very distinct from those of the surroundings. In these relatively open arid and semi-arid environments, the denser vegetation acts as a windbreak, effectively trapping wind-borne materials over time. Near the Atlantic coast, heuweltjies are very wide and tall, consisting of sandy sediments derived from beach sands. Moving further inland, away from these abundant sources of wind-borne sand, heuweltjies are typically smaller and more silt-rich, regardless of the kind of bedrock beneath them, indicating the accumulation of lesser quantities of finer wind-borne dust.

Our work led us to an entirely new explanation for the formation of heuweltjies. We concluded that the termites are not directly responsible for the actual transport and addition of the bulk of soil materials found in the mounds. Rather, termites simply create localized nutrient-rich “islands” that support denser vegetation, which leads to the localized accumulation of wind-borne sediments in regularly-spaced mounds. Our proposed model explains not only the occurrence of heuweltjies of various ages in one place, but also geographic differences across western South Africa in the kinds of soils and sizes of heuweltjies. The full results of our work will be published in a research journal titled *Earth Surface Processes and Landforms*.

The significance of this research extends beyond satisfying the scientific curiosity of a handful of scientists. Landscapes covered with heuweltjies have been widely used for livestock grazing, with the result that the soils and original vegetation of the mounds have been severely damaged in many areas. Identifying the natural processes by which the mounds form provides essential information for planning conservation of soils and vegetation, and the potential restoration of severely impacted areas.

South African Roundabout

After Les returned to the United States, Matt and I prepared for our final trip: a two-week, 2,630 mile-long loop, visiting diverse environments throughout the country. We retraced some of our earlier routes northward through Namaqualand to the city of Springbok, eastward halfway across South Africa to Kimberley, southward to Port Elizabeth on the Indian Ocean coast, then returning westward to Cape Town. We continued to collect information on heuweltjies at additional sites even as we observed diverse environments including dry savannas, native grasslands, Karoo shrublands, and indigenous forests near the southern Indian Ocean coast.



Joe McAuliffe and Matt King beneath South African rainbow.

The entire seven weeks of our time in South Africa was a spectacular experience for both of us. It was truly the trip of a lifetime. Although so much had been seen and accomplished, we realized how much more there was to learn about South Africa – its environments, plants and animals, and people. No sooner had we departed than I started thinking about when I would next return!

A generous gift to the Garden from Mrs. Nancy Swanson funded Dr. McAuliffe's and Matthew King's travel and research in South Africa.

A distant FAMILY REUNION

Humankind originated in Africa, and from there dispersed to eventually occupy both hemispheres. People are relative newcomers to the Americas, having migrated here only within the past few tens of thousands of years. In contrast, the human history in Africa reaches back more than a hundred times longer through a long chain of ancestors – from modern humans, *Homo sapiens*, deeper down into the roots of our family tree – *Homo erectus*, *H. habilis*, and multiple species of *Australopithecus*. The first *Homo* appear in the fossil record nearly 2 million years ago; *Australopithecus* inhabited parts of Africa as early as 3.5 million years ago. Many kinds of scientific studies provide evidence of our evolutionary history. However, a much more personal appreciation of one's heritage comes when one is able to connect materially with an ancestor, however recent or distant.

At one of the sites we visited, Les McFadden was the first to pick up and recognize an Acheulean hand axe, a hand-sized piece of stone that had been shaped by a distant ancestor – *Homo erectus* – on the order of a million years ago. As Les held and examined the stone tool, his face radiated with wonder and delight. Since his father had just passed away, I felt so happy that he had this opportunity to connect in this special way with another ancestor, no matter how much further removed in time. What was the environment like when that distant ancestor walked here perhaps a million years ago? How did its maker use the stone tool? Might Les have been the first human to hold the tool in his hand since it was last used by its maker?



Les McFadden and Timm Hoffman on a barren desert pavement near Tankwa-Karoo National Park. Insert: One of the Acheulean hand axes we found.

DESIGNING the new MEMBERSHIP KIOSK

by Lauren Svorinic, Individual Giving Manager

The new Membership Kiosk at the Garden's entrance opened in November 2013 replacing the outdated burgundy tent hosted by the Member Services team. The new structure features imaginative design, repurposed materials, and a modern living wall display. Scott Osteen, a member of the Garden's Monarch Council—a board-appointed committee of emerging leaders—shared his experience of working with the Garden's staff as they planned and developed the new structure.

How were you approached about the Membership Kiosk renovations?
Elaine McGinn, Director of Planning and Exhibits, asked me if the firm that I work with, DWL Architects, might be interested in designing a structure based on a shipping container. We loved the idea of repurposing something like that and held an office-wide charette, a design challenge, to develop ideas.

How did the design evolve as a result of the charette?
Trying to come up with solutions using materials that would otherwise be discarded always provides an excellent challenge. We must have gone through 40 different schemes before we settled on the handful that we presented to the Garden.

What were some of the challenges faced during the design process?
We all agreed that the Kiosk should be very open. It became apparent that we would want to cut large portions of the shipping container out, which would create structural problems. Ultimately, we decided it would be better to search

for other repurposed materials to use, which would give us more control over the design and make-up of the structure.

How were repurposed materials used in the structure?

180 Degrees, a local design-build company, gave us access to their warehouse, which contained a treasure trove of materials left over from previous projects. We set aside miscellaneous steel, wood, stone, etc., and then redesigned the Kiosk with those materials in mind. The result was a design that is about 75% recycled materials.

What is your favorite element of the Membership Kiosk design?
We had originally designed the structure to have a concrete floor, but instead were able to pave it with gorgeous limestone disks. I really like the disks not just for their attractive appearance, but also because they are actually waste from stone that had been cut for a previous project. In addition, the wood paneling and countertop surface were constructed from crates that the stone was originally shipped in, which I think is a nice connection between these two materials.



The new membership kiosk features a living wall and video display highlighting programming in the Garden.

What is your role as a member of the Monarch Council?
As a member of the Monarch Council, I have an exceptional opportunity to participate at the Garden in so many ways including being a part of various planning committees and miscellaneous projects such as this one. I think that engagement of emerging professionals is critical, especially now as we see so many plans for growth taking shape throughout the Garden. I see the Monarch Council as part of the next generation of leadership that will keep the Garden healthy and growing over the coming decades.

OUR SAGUARO LANDSCAPE

by Veronica Nixon, GIS Specialist

Towering saguaros (*Carnegiea gigantea*) are a familiar feature of the Garden landscape, however very little is known about the characteristics of the population as a whole. How many saguaros are growing at the Garden? Where are they? How tall are they? What is their condition?

To answer these questions and many more, a comprehensive inventory of the saguaro collection of the Desert Botanical Garden was recently carried out by Living Collections staff and volunteers. The goal of the inventory was to locate, map, measure, photograph, and assess the condition of every saguaro growing on the Garden's 140-acre grounds. We used Geographic Information System (GIS) software to manage the inventory as well as to analyze the data and produce maps. The results led to some surprising discoveries.

Conducting the Inventory

To map and measure the saguaros, we used a survey grade GPS and a laser range finder in addition to more traditional calipers and measuring tape. Ten research volunteers worked alongside four research staff to carry out the inventory between January 2012 and May 2013. We worked in rugged conditions, with temperatures throughout the project ranging from 40 degrees to 110 degrees. Maneuvering into some particularly densely planted areas inspired the term "cactus twister."

In addition to height and diameter, data was collected pertaining to the condition of each saguaro, whether it was caged to protect it from rabbit predation, and a count of arms. Lastly, a photograph was taken of each plant to capture additional information about its condition and situation in the Garden. Each saguaro was tagged with a unique accession number so it can be tracked in our Living Collections Management System (LCMS). Equipped with iPads, we entered inventory data into the LCMS as we measured each plant. All of the inventory data is accessible to staff and the public at www.livingcollections.org for online research.

To conduct your own saguaro research, you might try entering *Carnegiea gigantea* into the "Quick Search" field to map all of the saguaros at the Garden. If you want to search using more refined criteria, click the "Accessions" link, then enter *Carnegiea gigantea* into the "Taxon" field and fill in additional search fields of your choosing.



3D rendering of the Garden's saguaro landscape.



Volunteers measuring a saguaro below the butte.

Surveyors find a lot of Saguaros

After combing the grounds, hunting beneath every tree and shrub, and discovering saguaros as little as one inch tall, we now know that we have nearly a thousand growing at the Garden (985 as of February 1, 2014)! The survey revealed that the vast majority are located in the southern half of the Garden, with only a handful growing

in the North Preserve (area shown in orange in Figure 1). As the saguaros in the North Preserve are found almost entirely along washes, it's clear that availability of water and associated plant cover drives the location of saguaros in this area.

Juvenile saguaros (shown in green in Figure 1) were found growing wild in all areas of the property apart from the North Preserve. To find out why they aren't growing there, horticulturalist Einav Henenson recently carried out an informal study of the soil texture in the North Preserve. She believes that the lack of juvenile saguaros in this area may be due to a combination of factors that include unsuitable soil conditions and lack of necessary nurse plant cover.

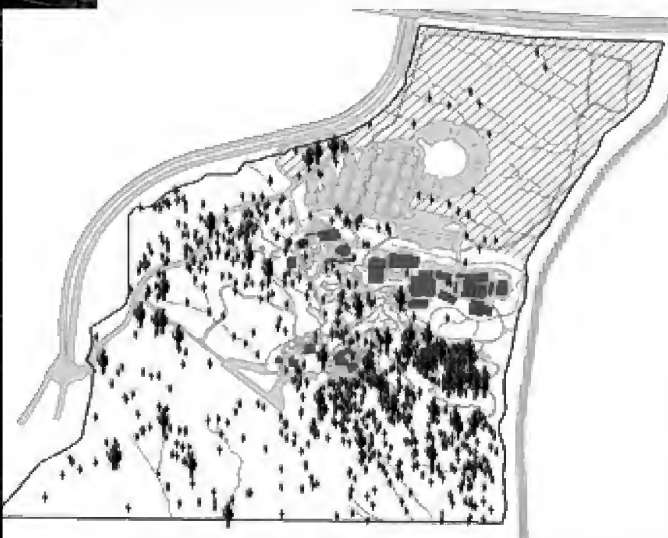


Figure 1. Spatial distribution of young saguaros at the Garden.

Figure 2 shows the number of saguaros counted in various height brackets. The distribution of saguaro heights indicates that the largest number of saguaros are 14 to 18 feet tall. The count tapers off rapidly above 18 feet, with only a handful of saguaros between 26 and 30 feet tall. In contrast, there are more than 100 saguaros under two feet tall. The disproportionately large number of young saguaros is partly the result of recent horticultural plantings, but is also because of higher levels of natural reproduction within the last 30 years.

In addition to measuring each saguaro, we assessed its condition on a scale ranging from excellent to poor. A saguaro was considered

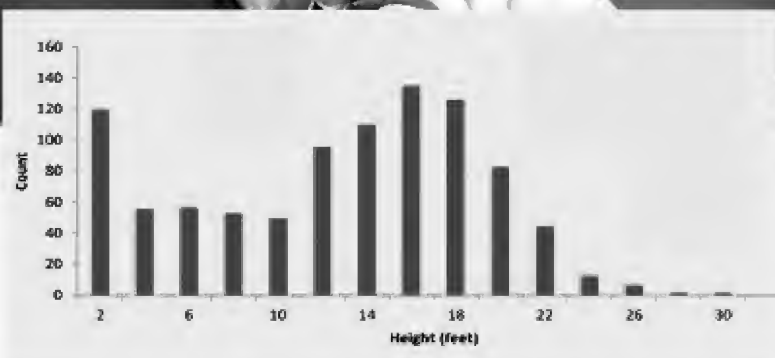


Figure 2. Statistical distribution of saguaro heights.

to be in excellent condition, for example, if there were no visible signs of rabbit predation, rot, frost, or sun scorch. Conversely, if a saguaro had unhealed rabbit predation, broken arms, oozing rot, or recent sun scorch, it was considered to be in poor condition.

Using the Data

This map (Figure 3) was prepared for Ray Leimkuehler, the horticulturalist who manages the *Plants and People of the Sonoran Desert Trail*. He requested the map to get a sense of the condition of the saguaros along the trail that are most visible from a visitor's perspective. The map depicts each saguaro in proportion to its measured height and highlights saguaros in poor condition in red. A 25-foot-wide zone along the trail indicates the saguaros that are most visible from the visitor perspective. The red saguaro in the upper left of the map is, incidentally, the tallest saguaro at the Garden at 29.3 feet. Leimkuehler assures us that, despite having sustained significant damage in the past, it may live another 20-30 years.

Mapping and inventory work have provided a detailed snapshot of the current status of our saguaro collection. This inventory will serve as a baseline dataset to assess long-term changes in the population. With it, and building from the height measurements, we hope to soon tackle the question of 'How Old is That Saguaro?' as posed by Tom Gatz in a previous issue of *The Sonoran Quarterly* (see *The Sonoran Quarterly* Vol. 65, No. 1, 2011, p. 16-18 or available at dbg.org/sqonline).

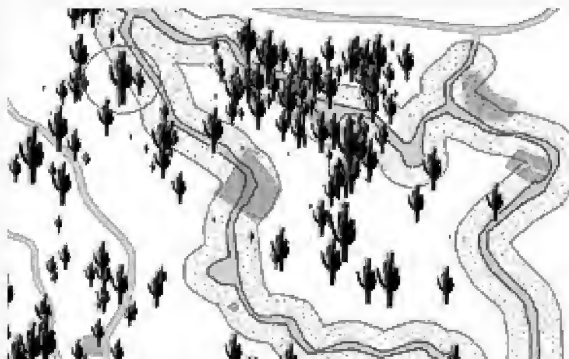
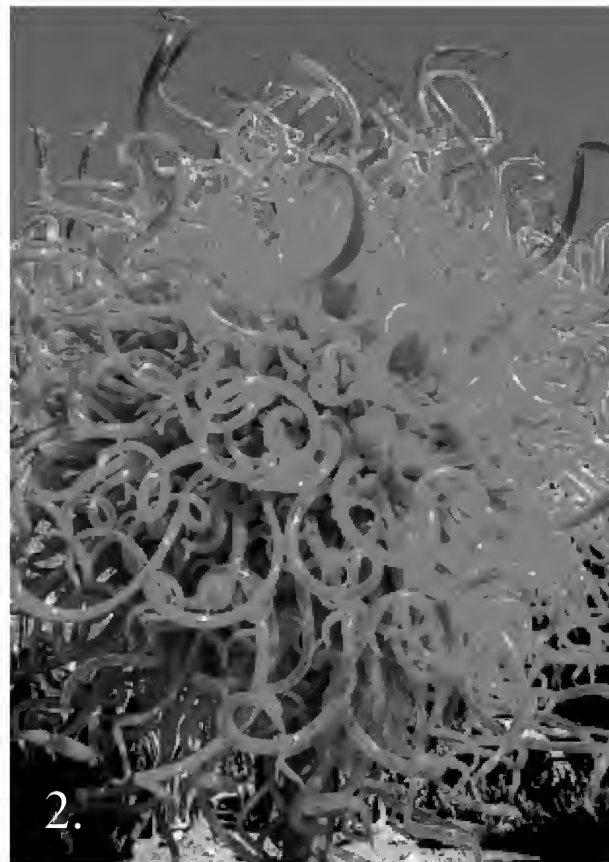


Figure 3. Analysis of saguaros on the *Plants and People of the Sonoran Desert Trail*.

Acknowledgments: Raul Puente conceived the idea of the saguaro inventory. Ann Drosendahl, Dylan Martin, Donna Lorch, Anita Peterson, Elizabeth Taddiken, Judy Thompson, Al Rodney, Leslie Towill, Clif Sawyer, Sharon Gentile, Bob Miller, Sharon Shapiro and Dottie Dudgeon carried out the data collection. John Earle and Demetrios Vlachos put it all in perspective by sharing their experience of growing up at and working in the Garden when some of the early saguaros were being planted.



NATURE *and* ART

by Elaine McGinn, Director of Planning and Exhibits
and Brian Kissinger, Director of Horticulture

ART TAKES NATURE AS ITS MODEL – *Aristotle*

Walk through any art museum in the world and you will see paintings and sculpture depicting nature. Conversely, a stroll through a garden offers nature as art through plants and landscapes that capture the imagination.

Gardens provide a unique venue for art, allowing the interaction between the man-made and the organic to be viewed in one space. This interaction revitalizes our relationship with nature and creates new ways of seeing our plant collections and landscape. In the Garden, art can be interpreted through many venues such as plant displays, hardscape features such as water fountains, lighting and seating areas, and even in the landscape. All form a relationship between nature and humans that is intrinsic to our appreciation of it as art.

The *Chihuly in the Garden* exhibition provides us with a new opportunity to explore the relationship between art and nature as dazzling glass works of art are juxtaposed against the bold, sculptural forms of cactus and succulent plants. Look for these installations in particular as you enjoy this alluring exhibition.

Discover for yourself which of the 21 installations will be your favorite. *Chihuly in the Garden* will run until May 18, 2014.

TIMED ADMISSIONS

8 a.m. - Noon, 12 - 4 p.m., 4 - 8 p.m.

Chihuly After Dark

8 p.m. - Midnight

March 1, 8, 15, 22, 29, April 5, 12, 19

Advanced reservations and tickets are highly recommended.

Visit dbg.org/chihuly for details.



1. *NEODYMIUM REEDS* and *BLACK NIJIMA*
FLOATS – agave bed

The *Neodymium Reeds* nestled among the *Agave lurida* mimic the vertical stalks of these plants. The rosette form of the agave provides a strong base for the reeds. At night the light reflects off the canopy of the trees while the silhouettes of the agaves provide a magnificent backdrop.

Neodymium Reeds and Black Nijima Floats, 2013
Desert Botanical Garden, Phoenix

2. *SUMMER SUN* (detail) – large cactus forms

This *Chihuly in the Garden* installation is spectacular in the desert light. Displayed among the Garden's oldest and largest cacti, it mimics the movement of the *Stetsonia coryne* cactus arms.

Summer Sun, 2013
Desert Botanical Garden, Phoenix

3. *CATTAILS* in the *BERLIN AGAVE YUCCA*
FOREST – yuccas and agaves

The vibrant red tint of these sculptures stands out against the greens and blues of the *Yucca filifera* and the *Agave delmateri*. The gentle forms of the glass contrasts nicely with the sentinel-like yuccas.

Cattails, 2013
Desert Botanical Garden, Phoenix

4. *YELLOW HERONS* on *CENTER FOR DESERT*
LIVING TRAIL – soft palette

The gentle exuberance of the *Yellow Herons* against the soft plant palette of herbs and perennials accentuates the softness of the lavenders, rosemary, and germander.

Yellow Herons, 2013
Desert Botanical Garden, Phoenix



Chihuly in the Garden presented by

CHASE  **J.P.Morgan**

Chihuly at Night sponsored by

 **aps**

ESTELLE & PAUL LORAH

“Planting the Garden’s Future”

by Susan Shattuck, Gift Planning Officer

Estelle and Paul found a wonderful place for learning and social exchange in the Garden. They made many lasting friendships here. Their legacy gift celebrates those friends as well as the Garden that they loved.

Early in 2013 the Desert Botanical Garden lost long-time member and volunteer Paul Lorah. Both he and his wife, Estelle (who predeceased Paul in 2006), were familiar friends at the Desert Botanical Garden.

Paul and Estelle grew up in Ohio. Later, as a young couple and during their respective employment as an engineer and as a registered nurse, Paul and Estelle took summer vacation time to explore Arizona. When an engineering job was identified with Motorola, Government Division, they quickly followed it west with a move to the desert.

Estelle became a Volunteer in the Garden in 1986 as a member of the Garden’s second official Docent Class. She was a Wednesday horticulture aide and a seed room volunteer. Estelle invested her time in the Education Department and volunteered with Temporary Office Personnel (TOPS). Her energy and efficiency as the *Luminaria* “Cookie Queen” became an integral part of the event’s early success. Estelle became a Hardy Perennial in 1996, recognized for more than 10 years of volunteer service.

After his retirement from Motorola, Paul also became a Volunteer in the Garden. He measured rainfall and cactus growth for the Horticulture Department. In later years he helped out regularly in the Business Office.

In retirement Paul became an avid reader, devouring histories and mysteries with a particular love for the novels of Tony Hillerman and the author’s Native American protagonists.

Paul was also an amazing woodworker who turned bowls that are truly works of art. Ken Schutz displays a Paul Lorah bowl in his Garden



Paul visited the Garden and Garden friends in 2012.

office, and Garden Trustee Hazel Hare proudly features one of his creations in her collection. On occasion Paul and Estelle would display his artistry at Garden art shows.

“Talk about being devoted volunteers!” comments former Executive Director Carolyn O’Malley. “The Lorahs were two of the first volunteer members to step up and become legacy donors.” They became a part of the Garden’s Sonoran Circle during the 60 x 60 Campaign, which sought to identify 60 legacy donors before the Garden’s 60th Anniversary in 1999. Now the Sonoran Circle boasts 213 donors and promises a future of generous planned gifts.



At the time of Estelle's death, Paul and many Garden friends provided for a memorial bench in her honor. Located on the short-cut trail north of Webster Auditorium, facing a peaceful bubbling fountain, it will soon bear a new plaque to recognize their mutual affection for and involvement in the Garden.

Estelle and Paul left a significant, unrestricted gift to the Garden that was realized when Paul passed away in 2013. Because they had expressed a preference for supporting education and horticulture capital projects, the Garden's Executive Committee is honoring their interests by designating the Lorah's legacy contribution to the following projects:

- Creating the Desert Gardening Resource Center. Renovation of the Archer House classroom will allow the Garden to create an experiential learning environment for our students through technological advancement. Included in the renovation is a digital learning lab which will greatly enhance the Garden's popular photography classes.
- Supporting construction of a state-of-the-art Horticulture Center. This complex will house our collection and will address the Garden's critical need for greenhouses, shade houses, and seed storage. There will be space for plant propagation, potting and seed work, and for education and training opportunities. Built to showcase our exceptional plant collection, the facilities will also be used for behind-the-scenes exhibits, tours, and activities.

As part of *The Saguaro Initiative*, construction of this new facility will begin in 2015 with completion slated for 2017. The new Horticulture Center will allow visitors to really see the Garden at work.

Estelle and Paul found a wonderful place for learning and social exchange in the Garden. They made many lasting friendships here. Their legacy gift celebrates those friends as well as the Garden that they loved.

Bob Tancer, former horticulture aide and current *Trustee Emeritus*, fondly remembers the Lorahs. "I met Paul and Estelle in the early 1990s, when



A memorial bench commemorating Estelle and Paul Lorah's philanthropic support.

I started out as a horticulture volunteer. They were so friendly and welcoming as they oriented me into the complex volunteer organization that supported the Garden. This was long before the volunteer center was completed—we were located at the time in several trailers. We always shared our morning break together and became friends over a long period of time. As chair of the Education Advisory Committee, I am particularly happy that Paul and Estelle's gift will expand the photography offerings of the adult education program and the Desert Landscape School. Paul and Estelle represent volunteerism at its very best!"

I had the pleasure of joining Paul for periodic lunches. He told lots of stories and shared some of his best memories of their Garden involvement. After his move to Desert Jewel Assisted Living, I arranged several visits to keep Paul connected with a few Garden friends. Our efforts to brighten his day brightened our own as well. In 2012, we planned a very special morning gathering at the Garden with old friends.



Paul with volunteers l to r: Susan Ahearn, Sidney Allen and Jean Besich.

Paul and Estelle Lorah left their mark on the Desert Botanical Garden. They have helped to shape its future. We are grateful for their commitment and involvement. Their legacy will continue to benefit the volunteers, members, and visitors of tomorrow.

Leave Your Own Legacy

For more information on the Garden's planned giving program, visit dbg.org/membership (Planned Giving) or contact Susan Shattuck by phone at 480 941.3507 or by email at sshattuck@dbg.org.

75th ANNIVERSARY



Chihuly Gala Memories

On November 8, 2013, the Desert Botanical Garden and event Chairs Lee and Mike Cohn welcomed 630 friends of the Garden to a celebration of Dale Chihuly's exhibition at an *Opening Night Gala & Preview*.

The evening began with a silent auction and guest exploration of the 21 Chihuly installations artfully placed side-by-side with the living plant collection. Dinner by Copper Square Kitchen/ Hyatt Regency Phoenix was served under the stars in the *Sybil B. Harrington Cactus and Succulent Galleries*, Stardust Foundation Plaza, and Ullman Terrace as Turning Point and The Jazz Experience entertained guests. The magical night included appearances by Fairies, courtesy of Southwest Shakespeare Company, a live performance by the Arizona Opera, and parting gifts that included a special Chihuly book.

Thanks to the dynamic Chihuly Gala Committee and generous supporters who are recognized on the *In Appreciation* pages of this issue, the Garden raised more than \$430,000 at the sold out event to benefit *The Saguaro Initiative*.



1. Bill Fenster, Carol Whiteman, Barbara Fenster, Randy & Carol Schilling, Ian & Tina Bruce
2. Liisa & Bill Wilder
3. Denise & Robert Delgado
4. Steve Evans, Margot & Dennis Knight

CELEBRATION HIGHLIGHTS

The Saguaro Initiative



The dream for a botanical garden in Phoenix began with desert plant enthusiast Gustaf Starck and philanthropist Gertrude Webster, who envisioned a garden that showcased and protected the beauty of the Sonoran Desert for future generations.

Today, our founders' remarkable and forward-thinking plan has been more than realized. The Garden is nationally recognized as a champion of plant conservation, a pioneer in the care and

display of desert plants, an innovator in life-long education, and a respected leader in Sonoran Desert research.

The Saguaro Initiative is the Garden's plan to build upon the founding vision for the next 75 years. The *Initiatives at a Glance* are outlined on our website. For more detailed information, we invite you to visit our website at <http://saguaroinitiative.dbg.org> or call us at 480 481.8160.

Garden Members Celebrate the Past and Help Shape the Future

Each fall the Garden invites our members to consider a charitable contribution in support of the Garden's year-end appeal. This year, the request included opportunities to support three of *The Saguaro Initiative* projects.

The Heritage Garden

North of historic Webster Auditorium are the Garden's original plantings, a dramatic reminder of the vision and legacy of our founders. The Heritage Garden will showcase historic plantings and highlight the Garden's popular giant cardones, planted in 1939.

Horticulture Center

The Horticulture Center will allow for proper care and expansion of the Garden's world-class plant collections. Educational space will provide members, visitors, and industry professionals an opportunity to see behind-the-scenes operations. It will also make available space for classes and public programs.

Butterfly Pavilion

The Garden proposes a new butterfly pavilion to be located on the *Harriet K. Maxwell Desert Wildflower Trail*. The expanded facility will feature educational exhibits that will include a caterpillar nursery and an emergence chamber to let visitors view all stages of a butterfly's life.

We thank our loyal Garden members who have made contributions totaling \$119,300 in support of the year-end appeal, including \$91,400 for annual programs and \$27,900 directed to *The Saguaro Initiative*.

Shape the Garden's future with a gift to *The Saguaro Initiative*. Give online at dbg.org/donate.

Reaching Our Goal

Gifts confirmed as of January 15, 2014

\$18 million

\$16 million

\$14 million

\$12 million

\$10 million

\$8 million

\$6 million

\$4 million

\$2 million

\$6.9 million

Thanks to our stellar Cabinet Members and generous supporters \$6.9M has been contributed as of January 15, 2014:

75th Anniversary Cabinet Chair: Bennett Dorrance

75th Anniversary Cabinet

Rebecca Ailes-Fine
Kate Baker
Oonagh Boppart
Lee Baumann Cohn
Mike Cohn
Jacquie Dorrance
Barton Faber
Peter Fine

Hazel Hare
Barbara Hoffnagle
Martha Hunter
Jan Lewis
Tom Lewis
Harry Papp
Rosellen C. Papp
Ken Schutz
Archer V. Shelton

75 Seventy-five Years of Gratitude and Recognition

With deep gratitude
and appreciation,
we acknowledge
the 75th Anniversary
Honorees

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Shirley and Thomas J. Bekey
Howard K. and Joy Berlin
Oonagh and John Boppart
Vera A. Carpenter Trust
Lee and Mike Cohn
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Carol and Randy Schilling
The Stardust Foundation
The Steele Foundation, Inc.
The Virginia M. Ullman
Foundation
Gertrude D. Webster
Barbara B. Weisz

by Lee Atonna, Garden docent

One of our 75th Anniversary celebration goals is to honor our original founders and significant stakeholders by publicly recognizing the individuals and organizations that have made exemplary philanthropic commitments to the Garden.

An Honor Recognition Committee, chaired by Trustee Carolyn O'Malley, led a team of dedicated volunteers that assisted the Development and Planning/Exhibits staffs in identifying and designing the way in which these philanthropists would be recognized.

Philanthropy, loosely defined, involves a spirit of goodwill, an active effort to help, and an altruistic offer of financial support. Gustaf Starck's dream for a botanical garden has, since he first erected his "Save the Desert" yard sign, provided ample opportunities to demonstrate this goodwill and altruism. Gertrude Divine Webster modeled how to transform a fledgling dream into a reality through her generous contributions and unstinting use of her ability to "woo the influential." Not even a World War could extinguish the shared dream of Gustaf, Gertrude, and the Arizona Cactus and Native Flora Society. The Garden, though barely viable, later renewed itself because of the generosity of Lou Ella Archer, who spearheaded the effort to buy enough memberships to realize the full impact of Gertrude's legacy.

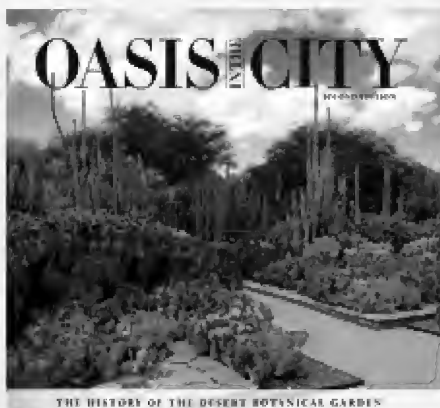
To embrace and memorialize our history requires that we gratefully recognize and acknowledge those whose philanthropy has made it possible for the Garden to continue to thrive and flourish for 75 years.

On February 13, 2014, the Garden unveiled a series of recognition plaques and feted the 75th Anniversary Honorees at a special luncheon. Each plaque features the honoree's photograph with a short quote. We invite you to take a stroll through the Garden in search of these plaques. Reading each honoree's statement – explaining why they have chosen to support the Desert Botanical Garden – will echo in your heart.

As Liberty Hyde Bailey, American horticulturist, botanist, and co-founder of the American Society for Horticultural Science wrote, "*A garden requires patient labor and attention. Plants do not grow merely to satisfy ambitions or to fulfill good intentions. They thrive because someone expended effort on them.*" We honor the philanthropists whose gifts have enabled the Desert Botanical Garden to give its plants and facilities this requisite labor and attention.

*Special thanks to Honor Recognition Committee
Volunteers Carolyn O'Malley, Dawn Goldman, and
Lee Atonna*

The Garden's History Book Blooms Again



In 2000, the Garden first published *Oasis in the City: The History of the Desert Botanical Garden*. Since that time, so much has occurred that it was decided to continue the history with the publication of a new edition for the 75th Anniversary of the Garden.

The idea for the original book came from Dr. William Huizingh, *Trustee Emeritus*. Fortunately, he generously agreed to return to lead the team for the second edition. Also joining him from the original

team was Trustee Carol Schilling and writer Tara A. Blanc. The first edition begins with Gustaf Stark and Gertrude Divine Webster working in the 1930s to establish the Garden. It concludes in 1999, just as the *Growing a Legacy for Generations* campaign was reaching its goal and the new facilities were being planned. The second edition, slightly restructured from the first edition, brings the story forward to the present time, with the Garden celebrating its first 75 years. The new edition is almost twice as big as the original, includes more color photography, and is designed to be an attractive addition to your coffee table collection.

Oasis in the City: The History of the Desert Botanical Garden sells for \$50 in the Garden Shop and online at gardenshop.dbg.org.



TRIBUTE TILES

by Lauren Svorinic, Individual Giving Manager

Botanical gardens have long been a popular location for commemorating special occasions or honoring the life of a loved one with a permanent tribute. The Garden is fortunate to house many thoughtful tribute installations, each with its own unique story and message to share with our members, visitors, and friends. Additionally, tributes support the Garden's mission by providing funding for annual programs, critical research, horticultural displays, and maintenance of the grounds.

In 2010, the Garden phased out the popular tribute bench program due to limited availability and maintenance challenges. At that time, the Donor Recognition Committee (DRC), a board-appointed group of trustees, volunteers, and staff supporting Garden recognition policies and procedures, began to look into new tribute opportunities.

After reviewing responses from a request for proposal, the committee selected local artist and former Garden employee Jim Sudal, who created a

unique collection of botanical-inspired tiles that have been installed on the patio of the *Center for Desert Living Trail (CDL)*. The series includes a prickly pear, desert lupine, firewheel daisies, and a family of butterflies—inspired, of course, by the plants and bright colors of CDL.

The tribute installation features a preliminary set of tiles that will be added to as new tribute gifts are made. There are two versions of each image offered. Tiles with an all-over color can be named with a minimum contribution of \$1,500. Tiles with a detailed, hand-painted image can be named with a minimum contribution of \$2,500. Tribute donors will also receive a duplicate version of their tile to place in their own home or garden, or to give to their loved one recognized on the tribute installation.

For questions about tribute opportunities at the Desert Botanical Garden, please contact Lauren Svorinic at 480 481.8147 or lsvorinic@dbg.org.

Special thanks to Jim Sudal Ceramic Design for donated time and materials in support of the tribute installation.



Tiles with an all-over color can be named with a minimum contribution of \$1,500. Tiles with a detailed, hand-painted image can be named with a minimum contribution of \$2,500. Tribute donors will also receive a duplicate version of their tile to place in their own home or garden, or to give to their loved one recognized on the tribute installation.



Raul Puente Delivers Keynote Address at a Botanical Conference in Mexico

From November 6 to 11, 2013, Raul Puente, the curator of living collections at the Desert Botanical Garden, traveled to the state of Sinaloa, Mexico, to give talks at the 26th National Conference of the Association of Botanical Gardens of Mexico (AMJB). The conference took place at the Benjamín F. Johnston Botanical Garden in Los Mochis, Sinaloa.

Puente delivered a one-hour-long keynote address entitled: "Curatorial Procedures in Botanical Gardens; the Desert Botanical Garden." In this talk he shared with the attendees the curatorial procedures followed at the Desert Botanical Garden for maintaining the Living Collection database, mapping, and accessioning. He also participated in a second talk: "Sentinel Plant Network Seeks Member Gardens in Mexico," a 20-minute talk presented in collaboration with Casey Sclar, executive director of the American Public Gardens Association (APGA) and Neil Gerlowski, director of the Vallarta Botanical Garden, in Jalisco.

During the conference they attended workshops and presentations from various botanical gardens and learned about their efforts in *ex-situ* conservation of rare and threatened plants of Mexico. They also enjoyed a field trip to Topolobampo Bay, Sinaloa, and visited the Culiacan Botanic Garden in Culiacan, Sinaloa.

Piper Fellowship Awarded to Garden Conservation Leader

Dr. Kimberlie McCue, Program Director, Conservation of Threatened Species and Habitats, has been awarded a Piper Fellowship by Virginia G. Piper Charitable Trust.

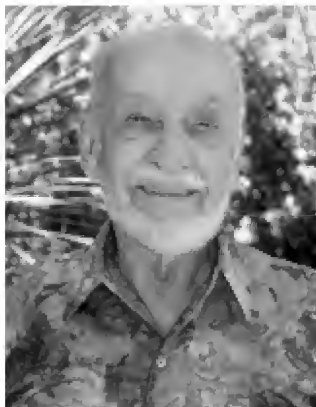
The Piper Fellowship program supports the professional development of outstanding senior executives of nonprofit organizations serving Maricopa County. Fellows are awarded up to \$30,000 for study and travel expenses to be used over a one to two month sabbatical period.

Dr. McCue will use her Fellowship to focus on exploration of conservation messaging, marketing, and promotion for the purposes of connecting people with the importance of plants, the need to actively engage in their conservation, and the important role that botanical gardens are playing in this realm. During her sabbatical, McCue will spend time at the Wildlife Conservation Society in New York, the North Carolina Botanical Garden, the Atlanta Botanical Garden, and the Royal Botanical Gardens in Ontario, Canada. Piper Trust also encourages Fellows to include time for personal renewal and to this end McCue will heed the great John Muir's advice to "Keep close to Nature's heart...spend a week in the woods" by taking a photography class at Yosemite National Park.



McCue becomes the fourth member of the Garden staff to be awarded a Piper Fellowship, following Executive Director Ken Schutz, Director of Planning and Exhibits Elaine McGinn, and Deputy Director MaryLynn Mack.





Garden Partners with Arizona State University to Support Graduate Training

The Huizingh Desert Research Fellowship was established in 2011 in honor of Dr. William Huizingh, long-time supporter and former president of the Garden's board of trustees.

Craig Weatherup, retired President and CEO of PepsiCo, led the successful effort to fund the fellowship, which attracted gifts from Dr. Huizingh's many friends including former students. One of the fellowship's purposes is to enhance the Garden's research program through direct involvement in advanced training of graduate students in the plant sciences.

To this end, in November 2013 the Desert Botanical Garden and the School of Life Sciences, Arizona State University, entered into an agreement by which doctoral students co-advised by Garden researchers and university faculty would be jointly funded by both institutions. Garden funds of the Huizingh Desert Research Fellowship will be matched by Arizona State University to provide financial support for doctoral student research. A joint committee consisting of School of Life Sciences faculty and Garden researchers will evaluate graduate student applications and select recipients, who will be awarded five years of joint fellowship funding. The first fellowship is expected to be awarded in fall 2015. This fellowship is a tremendous way for the Garden's research program to share the expertise of its scientists with the rest of the world. We thank those who contributed to the Huizingh Desert Research Fellowship. Their generosity helps ensure the continuation and enlargement of these efforts in training the next generation of plant researchers.

Introducing New Agavaceae/Aloaceae Collections Manager Fritz Light

Fritz Light grew up in Philadelphia, where he studied music and theatrical art at Penn State University before relocating to San Diego, where he spent seven years as a newspaper photographer and writer.



The work was great fun, but with the decline of print journalism and the rise of digitally-based photography, Light decided to pursue a more scientific career. He returned to school and earned a Certificate in Landscape Management, an MS in Plant Protection Science, and an MA in Biology from Cal Poly,

San Luis Obispo, as well as a California Agricultural Pest Control Advisor license. A substantial part of his graduate school experience included curating the Cal Poly Plant Conservatory's collection of desert plants, where he combated greenhouse pests on cacti and succulents using Integrated Pest Management techniques.

Light looks forward to applying those principles and techniques to protecting the plants here from the damage caused by the typical greenhouse and landscape pests. Light is excited to work with plants that he knows and loves but has not been able to raise in California. He has felt welcomed by employees and volunteers right from the start.

In his free time, Light likes to hike and explore wild landscapes, play drums, write music, play disc golf (using a Frisbee), and attend live jazz shows. When he can, he visits his brother's family, and likes to teach his two-year-old nephew new tricks on the drum set.

Photo Credits

Page 2 Ken Schutz - Jim Poulin
Page 2 Wildflowers - Adam Rodriguez
Page 3 Wildflowers and butterfly - Adam Rodriguez
Pages 4-8 South African Research Roundabout -
Joe McAuliffe unless noted
Page 9 Living wall display and Membership Kiosk -
Lauren Svorinic
Pages 10-11 Photo, illustrations and graph - Veronica Nixon

Pages 12-13 *Chihuly in the Garden* exhibition - Chihuly Studio
Page 14 Early photo Estelle & Paul Lorah - Courtesy of
Schilling Library Archives
Pages 14-15 Paul Lorah, memorial bench, Garden friends -
Susan Shattuck
Page 16 Chihuly Gala photos - Darrylee Cohen -
Haute Photography
Page 19 Tribute Tiles - Lauren Svorinic

Page 20 Isla de las Patos, Sinaloa, Mexico - Raul Puente
Page 20 Dr. Kimberlie McCue - Adrienne Encinas
Page 21 Dr. Huizingh - Desert Botanical Garden
Page 21 Fritz Light - Brian Kissinger
Back cover: Plant Sale - Adam Rodriguez
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in appreciation

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grateful to all 33,268 members
and donors for their support.
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Founder's Circle members and
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Included are memberships and
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\$25,000 +

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The Desert Botanical Garden Mission

The Garden's commitment to the community is to advance excellence in education, research, exhibition, and conservation of desert plants of the world with emphasis on the Southwestern United States. We will ensure that the Garden is always a compelling attraction that brings to life the many wonders of the desert.



FREE WI-FI is available in five locations within the Desert Botanical Garden: the area in front of Admissions, Ottosen Entry Garden, Boppert Courtyard, the Center for Desert Living Trail, and Ullman Terrace.

WiFi Zone



City of Phoenix

PHOENIX OFFICE OF ARTS AND CULTURE

Partial funding provided by the Phoenix Office of Arts and Culture through appropriations from the Phoenix City Council.



Spring Plant Sale

March 14 - 16 / Event Plaza

Garden Members Preview: Friday / March 14 / 7 a.m. - 5 p.m.

Open to the General Public: Saturday / March 15 / 7 a.m. - 5 p.m.

AND Sunday, March 16 / 9 a.m. - 5 p.m.

No admission charge to enter the Spring Plant Sale

Your one-stop shopping experience featuring the largest variety of arid-adapted plants and expert advice from Garden horticulturists and volunteers. A large variety of specialty retailers will be there, offering unique pottery and other garden accessories.

Sponsored by:



Shakespeare in the Garden

May 15 - 18, 22 - 25, 29 - June 1

Doors open at 6:30 p.m. / Performances start at 8 p.m.

Performance will be under 90 minutes

SPECIAL OUTDOOR EVENT!

FairyWorlds! is a new adaptation of Shakespeare's *A Midsummer Night's Dream* produced by the Southwest Shakespeare Company in partnership with the Desert Botanical Garden. This new vision, by Producing Artistic Director Jared Sakren, includes bold visual elements, stunning costumes, lighting and stage magic designed to highlight the surroundings of the Garden.

Performances will be held outdoors in the Garden's Event Plaza. Ticketing options are general admission or reserved bistro tables for up to four guests. A cash bar and food will be available, provided by Fabulous Food Fine Catering & Events.

General Seating: \$40 / Reserved Seating: \$55

Garden members receive a discount:

General Seating: \$35 use discount code BotanicalGA

Reserved Seating: \$50 use discount code Botanical

To Purchase Tickets: Order online at swshakespeare.org/fairyworlds

SONORAN QUARTERLY

FOR MEMBERS AND FRIENDS OF THE DESERT BOTANICAL GARDEN

PHOENIX, ARIZONA JUNE 2014, VOLUME 68, NO. 2



DESERT
BOTANICAL GARDEN
PHOENIX, ARIZONA



You might think things would slow down a little bit at the Garden. But to the contrary, there will be much activity in the months to come.



Shifting Gears

Just weeks ago, the Garden's second Chihuly exhibition closed after an incredible six-month run.

I would like to express my thanks to all of our members who so generously shared the Garden with hundreds of thousands more guests than we typically see in a spring season. I would also like to thank our sponsors—J. P. Morgan Chase and APS—for underwriting the *Chihuly in the Garden* exhibition. Without their support, it would not have been possible. Finally, I would like to thank the staff and volunteers who worked so hard throughout the run of the exhibit to make sure that each of our guests had a world-class experience—and, especially, for having done so always with a smile.

With such an effort behind us, you might think things would slow down a little bit at the Garden. But to the contrary, there will be much activity in the months to come. Soon we will begin construction on two new exhibits—the *Desert Terrace Gardens* and the *Jan and Tom Lewis*



Desert Portal. These major new exhibition areas will link the *Ottosen Entry Garden* with the Garden's core trail, offer amazing presentations of our cactus and succulent collections, and frame outstanding views of the Papago Park landscape. We will tell you more about these exciting new exhibits in future issues of *The Sonoran Quarterly*.

For now, I wish you a happy summer and invite you to cool off with us at one of the Garden's flashlight tours, offered every Thursday and Saturday night throughout June, July and August.

Ken Schutz
The Dr. William Huizingh Executive Director

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The Sonoran Quarterly

June 2014

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On the Cover

Mammillaria supertexta and Black-spined agave,
Agave macroacantha. Photo by Adam Rodriguez.

Back Cover

Flashlight Tours

Thursdays and Saturdays

May 24 - August 30 / 7 - 9 p.m.

Included with membership or paid
Garden admission.

Bring a flashlight and join us for an
evening of adventures!

From the Atacama to the Sonoran Desert:

An EXTRAORDINARY GIFT *from* Fred Kattermann



Left: Fred Kattermann collecting *Maihueiopsis ovata* during a 2004 expedition to Chile. Right top: Raul Puente (r) and Mario Lobos (l) collecting fruits of *Maihueiopsis ovata* in Banos del Toro, Chile. Right bottom: *Eriosyce* sp. in full bloom at Desert Botanical Garden.

by Raul Puente-Martinez, Curator of Living Collections

Early this year, Desert Botanical Garden received a donation of what may be the most significant private cactus collection in the United States: the collection of Fred Kattermann. It is remarkable in that all the plants are of known wild origin with full documentation. Most research institutions can only dream of acquiring such an extraordinarily complete collection.

Fred Kattermann was born in Germany in 1932 and moved to the United States in 1952. An electrical engineer by training, he became a serious cactus enthusiast in the late 1960s, when he ordered his first mix of cactus seeds. Kattermann started fieldwork in Chile in 1977, collecting several groups of cacti that included *Eriosyce* and *Copiapoa*. He carried out eleven expeditions to Chile, two to Peru, and one to Argentina. He discovered and described several taxa new to science and in 1994, he published the first taxonomic revision of the genus *Eriosyce*.

A longtime member and Fellow of the Cactus and Succulent Society of the United States, Kattermann has also been a member of the International Organization for Succulent Plant Studies (IOS) since 1985. He has published numerous articles on cacti in several journals around the world and is a frequent speaker in national and international cactus conferences. Kattermann has also been a research associate at Desert Botanical Garden and has partnered with our research staff in several expeditions in South America.

The current donation of cacti is actually the second installment of Kattermann's collection, as in 1992 we received an initial donation of more than 450 plants and 160 seed packages. Several other botanical gardens have also received specimens from him, including New York Botanical Garden; the University of California, Davis; and Huntington Botanical Garden. He has also shared specimens for taxonomic research with students in the United States and abroad.

Kattermann and the Garden

Kattermann's relationship with the Desert Botanical Garden began as a collaboration with the late Dr. Ted Anderson, who was the Garden's cactus specialist at that time. Dr. Anderson and Kattermann subsequently traveled together on various collecting trips to South America.

After attending the 1992 IOS Congress hosted by Desert Botanical Garden, Kattermann made his first donation of plants and seeds to the Garden. Many of the seeds were propagated by the late Patrick Quirk, then-curator of cacti, adding more than 70 plants to our collection. A few years later, after acclimating the plants in the greenhouses, about 150 specimens were planted in a bed in the old *Cactus House* and interpreted as the "Kattermann Collection." Many more of his plants have been on display in the South American cactus bed in the central area of the Garden.

In 1995, Fred Kattermann was formally invited by Desert Botanical Garden to become a Research Associate, a non-salaried position that allowed him to request funding, publish, and obtain collecting permits on behalf of the Garden. Although this position helped him to request some funding for his travels, the majority of his expenses were paid out of his own pocket. Two significant joint expeditions were carried out by Kattermann and other Garden staff: the 1994 Willard Research Expedition to Peru¹ with Dr. Ted Anderson, Dr. Joe McAuliffe, and Wendy Hodgson and, in 2004, to the Atacama Desert in Chile with Susan Aument of New York Botanical Garden and me. During both expeditions, participants were able to collect and study many cactus species in the company of botanists from Peru and Chile. Additionally, many herbarium specimens were made and shared with herbaria in both countries.

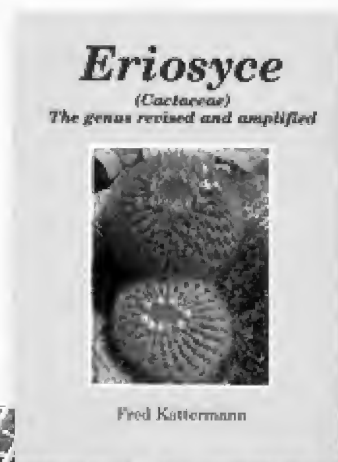
More recently, after the construction of the new *Sybil B. Harrington Cactus Gallery* in 2010, a number of Kattermann's plants, mostly *Eriosyce* and *Copiapoa*, were planted in the central bed of the gallery, where they have been on display ever since. A significant number of plants is maintained as a backup in the cactus greenhouse of the propagation area where they are maintained by Scott McMahon, Collections

Manager, Cactaceae. The addition of the newly donated plants has significantly increased the number of South American cactus species in our collection. The fact that each species is represented by plants from several localities in their natural distribution range makes this an extremely valuable resource for genetic study, as well as for ex-situ conservation.

Contributions to Cactus Taxonomy

Kattermann's most important contribution to cactus taxonomy to date was his revision of the genus *Eriosyce*², published in 1994. *Eriosyce*, a mostly Chilean group of globose to almost columnar cacti, are recognized by the presence of wool and bristles on the ovary and perianth tube. The flowers in some species are tubular, brightly colored, and adapted to hummingbird pollination. In his 176-page monograph, Kattermann described and illustrated 33 species, 21 subspecies, and 39 varieties with detailed line drawings and color photographs. This book is supported with contributions by others on systematics, scanning electron micrographs of seeds and pollen, and by an appendix with documentation of all accepted taxa. Several new species are described and numerous new name combinations are also proposed.

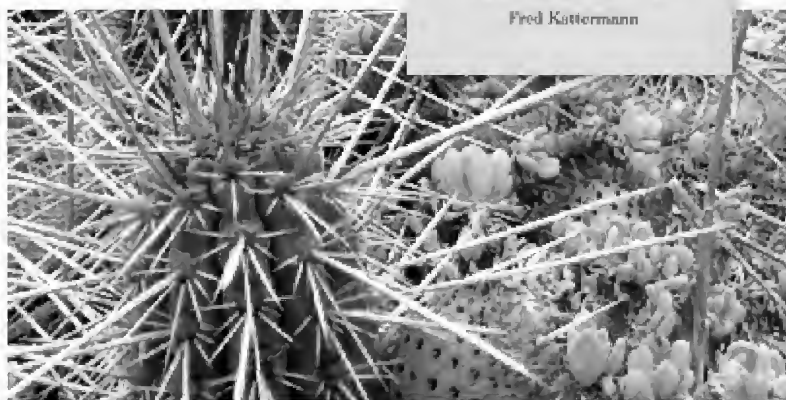
Another significant contribution was his publication of a series of articles in the *Cactus and Succulent Journal* on the subfamily Opuntioideae of Chile, in which he describes and illustrates the genera *Cylindropuntia*, *Cumulopuntia*, *Maihueniopsis*, and *Tunilla*³. These plants are closely related to prickly-pears (*Opuntia*), representing some of the earliest evolutionary members of the subfamily. The plants show somewhat primitive characters such as segmented, cylindrical, and highly branched stems, which gives them the appearance of big, spiny cushions, sometimes several feet in diameter. A large portion of the documentation for that series was done during the 2004 expedition to the Atacama Desert while traveling with staff from Desert Botanical Garden.



Insert: Cover of Kattermann's book.



Maihueniopsis crassispina near Vallenar, Chile.



Eulychnia castanea with ripe fruit near Pichidangui, Chile.



Top: The moving van covered with snow in Hillsville, NC. Center left: Ray Leimkuehler inspecting the van in Austin, TX. Center right: Driving in the snow along Pennsylvania. Bottom: The collection in its new location at Desert Botanical Garden.

Kattermann's total collection consists of more than 1,800 potted South American cacti that include members of the genera *Eriosyce*, *Copiapoa*, *Echinopsis*, *Eulychnia*, *Gymnocalycium*, *Maihueniopsis*, *Cumulopuntia*, and *Parodia*.

From New Jersey to Phoenix, Arizona
Transporting Kattermann's collection from Wantage, New Jersey, to the Desert Botanical Garden involved much work and preparation by members of the Research, Collections and Conservation, and Horticulture departments. The result of the planning included flying a team of two to New Jersey, renting a 16-foot-long moving van, building wooden shelves inside the van to safely store all the plants, and driving more than 2,500 miles back across the country with them. Once arrived, the collection required more than 500 square feet of bench space in the propagation greenhouse. After being maintained for many years in the heated greenhouses on Kattermann's property, it will take several seasons for these plants to sufficiently acclimate before some can be moved outside the greenhouse and planted in the Garden's grounds.

Significance of Kattermann's Collection

This collection was developed during more than 30 years of cactus research and collecting by Kattermann in the desert regions of Chile, northern Argentina, and Peru. His gift to the Garden consists of more than 1,800 potted South American cacti that include members of the genera *Eriosyce*, *Copiapoa*, *Echinopsis*, *Eulychnia*, *Gymnocalycium*, *Maihueniopsis*, *Cumulopuntia*, and *Parodia*.

Kattermann's recent donation added 1,327 new plants to the Garden's Living Collection. A total of 218 taxa are represented, of which 111 are new to our Living Collection. More significant is the fact that 92 taxa in this collection were listed as a priority in the Garden's 2011 Living Collection Plan. Along with the plants, Fred Kattermann provided all of their provenance data, along with numerous digital photographs and close-ups of plants in habitat. Many of those images are in the process of being added to the livingcollections.org database, where they will be available to researchers and the general public via the Internet.

Brian Kissinger, director of horticulture, regards the acquisition of the Kattermann Collection as an important example of teamwork between horticulture and research staff. Together, they identified the space requirements and conditions needed to properly house the diversity of cactus plants and brought them safely to Arizona. This successful collaboration is only one example of the exciting work that is going on at the Desert Botanical Garden.

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The 2004 Expedition to the Atacama Desert of Chile

by Raul Puente-Martinez, Curator of Living Collections

Years ago, I participated in one of Fred Kattermann's expeditions to the Atacama Desert in northern Chile. What was originally planned as a group of eight celebrities of the cactus world was reduced to only three people: Fred Kattermann, Susan Aument from New York Botanical Garden, and myself, Raul Puente-Martinez. Even though we were a small group, this did not keep us from traveling from the capital, Santiago, all the way to the city of Arica, near the border with Peru, for a total of 8,000 kilometers (5,000 miles). We crisscrossed the northern portion of the country from the coast, through the desert, and up the Andes. The goal of this expedition was to study and document all members of the subfamily Opuntioideae that are native to the Atacama Desert and Andes mountains in Chile.

During the expedition, we had the privilege of working with Chilean botanists Dr. Pedro León and his assistant Mario Lobos, both of whom are researchers at the National Seed Bank of Chile in La Serena. They traveled with us for a portion of the trip, collecting numerous fruit and seed samples of cacti and shrubs for their seed bank collection. While in Santiago, we visited with one of Kattermann's longtime associates, Adriana Hoffman, author of *Cactaceae en la Flora Silvestre de Chile*, a book beautifully illustrated with watercolor renderings of all cacti native to Chile¹.



Refueling the truck in Putre, Chile.




View of mountains along road to Laguna Santa Rosa, Chile.

In the northern portion of the country, we visited with botanist Raquel Pinto from the city of Iquique. Pinto took us on a quick trip to see a new species of *Eriosyce* that she had discovered while researching the vegetation of the lomas formation. The *lomas* (Spanish for "hills") are mountains along the coast that drop 600 meters to sea level. They typically look completely barren and denuded of vegetation until the heavy fog (*camanchaca*) or the rains of an El Niño year turns the landscape into an amazing carpet of *Alstroemeria* flowers and other plants growing from bulbs in the sandy soil.

At the end of this month-long expedition we had collected 110 plants, 57 seed packages, and made 87 herbarium vouchers. A duplicate set of vouchers was deposited in the Natural History Museum in Santiago, Chile, strengthening our relationship with them for future fieldwork. I also was able to write detailed descriptions of the opuntiods studied in the field for my own research. All the driving and the numerous hours spent cleaning plants and seeds, making labels and herbarium specimens, and working until late every night was nothing compared to the reward of seeing all those incredible landscapes of the real desert in the Atacama and the high mountains of the Andes.

Reference:

¹Hoffman, Adrianna E., *Cactaceae en la Flora Silvestre de Chile*. Fundacion Claudio Gay, Santiago, Chile, 1989.



Garden Researchers' Botanical Illustrations in Major Exhibit

The first botanical illustrators can be traced to stone relief carvings on the Egyptian tombs at Karnak.

by Wendy C. Hodgson, Herbarium Curator and Senior Research Botanist and Raul Puente-Martinez, Curator of the Living Collection

We were pleased to have been invited to display some of our botanical illustrations last year in an exhibit at the Arizona-Sonoran Desert Museum (ASDM) called “Botanical Art of the Sonoran Desert, Past and Present.” It was presented by The Sonoran Desert Florilegium Program in partnership with the Art Institute of the Arizona-Sonora Desert Museum.

The exceptional exhibit promoted the conservation and appreciation of Sonoran Desert plants through their representation in botanical art. Stories about the plants and about historic and contemporary artists and botanists greatly added to the visitors' experience. To see our work included in an exhibit graced by the work of such noted artists (many being mentors to us) as Lucretia Brezeale Hamilton¹, Mary Emily Eaton² and Paulus Roetter (well known for the beautiful cactus illustrations in “Report on the United States and Mexican Boundary Survey” Washington, D.C., 1859) was particularly exciting. Puente's botanical illustrations included Mexican passionflower and lesser swine-cress. Several illustrations used in Hodgson's *Food Plants of the Sonoran Desert*³ were exhibited, including saguaro processing, tepary beans, velvet and screwbean mesquite, Frémont wolfberry, Mexican oregano, barrel cactus, beargrass, and banana yucca.

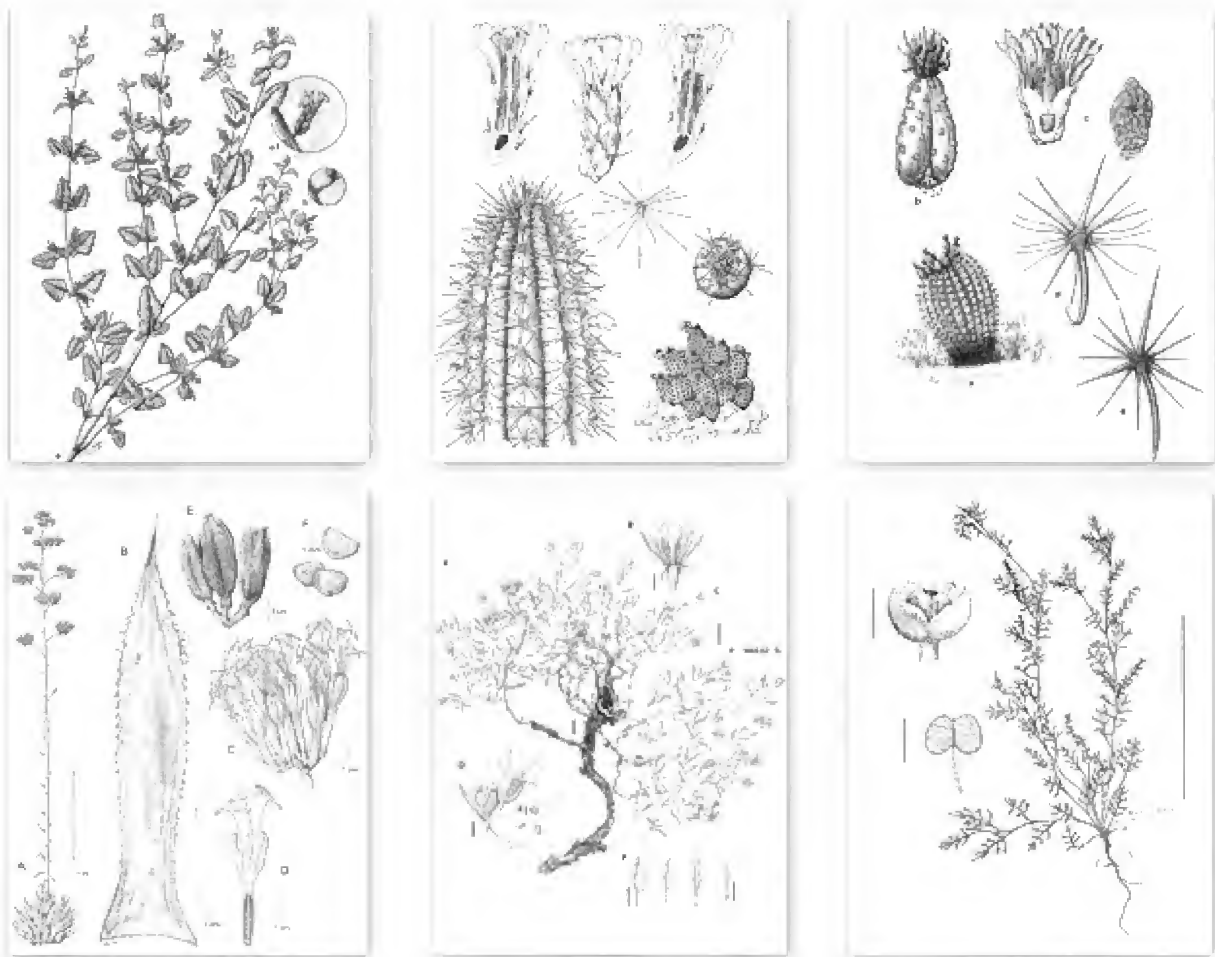
A Short History of Botanical Art and Illustration

The first botanical illustrators can be traced to stone relief carvings on the Egyptian tombs at Karnak. The first recognized botanical artist was Greek physician Cretavas in the first century! In the late fourteenth century, plant illustrations in herbals were printed using woodcuts. During the age of exploration beginning in the 16th century, botanists and horticulturists increased the demand for artists to accurately depict new species and other plant aspects.

The mid-eighteenth and nineteenth centuries were the golden age of botanical art. Several artists such as Ehret and Redouté emerged, who understood plant science and the demands of their art. During the twentieth century, interest in and the prestige of botanical art and illustration declined. In the latter part of the century, however, increased interest in ecology and horticulture helped generate a renewed interest for this art form, with individuals and organizations promoting public awareness of it. Botanical artists continue to provide beautiful illustrations for scientists, which are also appreciated by the public, communicating to people in ways that other forms cannot.

Contemporary Illustrators at the Desert Botanical Garden

We have prepared botanical illustrations for many years. Unbeknownst to most of us, Puente-Martinez has been illustrating plants for almost 20 years, focusing on his beloved prickly-pears, *nopales* and chollas, using his favorite medium, pen and ink. He is self-taught and learned by studying illustrations by Lucretia Brezeale Hamilton, Elvia Esparza, Albino Luna, and Alice Tangerini. In the late 1980s, he illustrated *The Legumes of San Luis Potosí, Mexico* and the subfamily *Opuntioideae* of the same state. Puente provided illustrations for the Vascular Plants of Arizona project, including the passion vine, silk tassel, and mustard families, as well as for several cacti. He is currently illustrating several new species of prickly-pear from Mexico that he recently discovered and is in the process of describing.



Pen and ink botanical illustrations displayed at the "Botanical Art of the Sonoran Desert, Past and Present" exhibit: Top row from top left: *Lippia palmeri* by Wendy Hodgson, *Echinocereus coccineus* ssp. *coccineus* claret-cup cactus by Karen Ann Gentle, *Ferocactus wislizeni* compass barrel by Wendy Hodgson. Bottom row from left: *Agave yavapaiensis* by Sandy Turico, *Mentzelia canyonensis* by Molly Gill and *Lepidium didymum* by Raul Puente.

Hodgson also is self-taught, although she focused on drawing animals since an early age. She began learning botanical illustration in the early 1970s by similarly studying Lucretia Hamilton's style and work. Besides providing all of the illustrations for her award-winning book, *Food Plants of the Sonoran Desert*³, Hodgson has also illustrated several species published by her colleagues and herself as new to science, using her favorite medium, pen and ink. She has also provided botanical illustrations for the *Arizona Rare Plant Field Guide*⁴, various Garden publications (*Saguaroland Bulletin*, *Agave*, *The Sonoran Quarterly*), and *Arizona Highways*, using various media.

Wendy has taught and mentored several botanical illustrators over the last 15 years. Projects that she coordinated or continues to coordinate involving illustrators' talents include publication of four species new to science, *Rare Plants of Grand Canyon* (where illustrators' artwork was featured in two major exhibits at Kolb Studio, South Rim from August-October 2010 and from February-April 2011), *Intermountain Flora* (of which several illustrations were exhibited in the Floralegium exhibit at ASDM), and a planned book on the cacti of Arizona. The North Mountain Visitor Center exhibit "*Drawing Us Together: Live, Learn and Fall in Love with the Flora of North Mountain*,"

which opened in late March, features many botanical illustrations of plants found in one of Phoenix's gems, the North Mountain Preserve.

Other researchers utilize the illustrators' talents for various projects, including Brassicaceae (mustards) of Sonora, under the leadership of Andrew Salywon, and a monograph of the Ephedraceae (Mormon-tea), authored by Stephanie Eckert-Bond, University of Alaska. All of these major works are made especially significant and valuable with the inclusion of scientifically accurate illustrations that are also exquisitely beautiful works of art.

References:

¹Gentry, H.S., *Agaves of Continental North America*, University of Arizona Press, 1982; Benson, L.D., *Cacti of Arizona*, University of Arizona press, 1969; Benson, L.D., *The Cacti of the United States and Canada*, Stanford University Press, 1982.

²N.L. and J.N. Rose, two-volume monograph *Cactaceae*, Carnegie Institution, 1919-1923.

³Hodgson, Wendy, *Food Plants of the Sonoran Desert*, University of Arizona Press, 2001.

⁴Arizona Rare Plant Committee, *Arizona Rare Plant Field Guide*, 2001.

Thanks to Elaine Hultgren, who provided the authors a short history of botanical art and illustration.



The Delightful Genus

Mammillaria

by Scott McMahon, Collections Manager, Cactaceae

All species have flowers produced in a ring below the apex that are more or less campanulate (bell-shaped).

***Mammillaria* and other amazing plants can be purchased at the Fall Plant Sale, October 17 - 19, 2014.**

Among the more than 100 genera in the cactus family (Cactaceae), the genus *Mammillaria* stands out as one of the most colorful and popular among cactus enthusiasts. Their small size makes them convenient for people just starting a collection, and the characteristic ring of flowers is irresistible to the eye. The spines can be all one color and size or vary greatly in length and color patterns, always neatly arranged.

Development of the Genus Description

The first species was described in 1753 by Carolus Linnaeus, who gave it the name *Cactus mammillaris*. The name is from the Latin *mammilla*, meaning nipple, which refers to the very pronounced tubercles, the distinctive feature of the genus. The tubercles emerge from the apex in precise left or right spiral patterns, following a mathematical formula known as the Fibonacci sequence. Drawings of the plants go back to at least the early 1700s.

Adrian Haworth set up the genus *Mammillaria* in 1812 with a description of the type species *Mammillaria simplex*, later to be named *Mammillaria mammillaris*. This species comes from Venezuela and the neighboring islands and is seldom seen in cultivation. Britton and Rose's work, *The Cactaceae*¹ from 1920 includes a description of the genus that is still considered accurate. All species have flowers produced in a ring below the apex that are more or less campanulate (bell-shaped). Numbers and colors of central and radial spines, shapes of the tubercles, the presence of milky sap, and other factors help differentiate the species. Other factors separate them from similar tuberculate genera such as *Coryphantha*, *Escobaria*, and *Acharagma*.

Above left: *Mammillaria ernestii*
Above right: *Mammillaria standleyi*



This page - clockwise from the left: *Mammillaria tetrancistra*, *M. nivosa*, *M. grahamii*, *M. perezdelarosae*

such as rocky hillsides and poorly developed soils that are low in nutrients. It is in these niche areas that cacti can thrive where other plants struggle. Seed distribution is carried out by birds passing seeds through their digestive tracts, so plants can end up germinating almost anywhere.

In climates where the sun is not as intense or along coastal areas where the humidity is high, *Mammillarias* can grow in more exposed areas. In the desert Southwest and neighboring Mexican states, however, they will be found growing among rocks or near shrubs that offer some relief from the hot sun. Our own local species, *M. grahamii*, is common in the mountain preserves, where it can be found near rocks or under a bursage plant, for example. Specimens in the Garden are planted among rocks where the roots can find refuge underneath, and in diffused light, such as under a tree or shade structure.

Mammillarias come from nearly every corner of Mexico, the foundation of the genus, with a large concentration of taxa in the Baja California area, including the surrounding islands. A few species have made their way into the southwest United States with *M. tetrancistra* being the northernmost, reaching into Nevada and Utah. Four species are dispersed through Central America, the Caribbean, and northern South America.

Following Britton and Rose's work, Craig published *The Mammillaria Handbook*² in 1945, increasing the number of species from 140 to 260. In the 1960s, Backeberg published *Die Cactaceae*³ during the post WWII era of road building and exploration in Mexico. This period of the first half of the twentieth century is known to cactus collectors as the era of the "splitters," when taxonomists were describing species based on minor physical differences, thereby increasing the numbers of taxa. Since the 1970s, more work has been done on relationships within the Cactaceae based on similarities, reducing the numbers of species including those in *Mammillaria*.

We are now in the age of the "lumpers." Some species get submerged into others, while others are reduced to subspecies status. Pilbeam's⁴, Luthy's, and Hunt's works on the genus are currently the most complete compilations. Still, there are 171 species of *Mammillaria*, divided into six subgenera with the largest subgenus, *Mammillaria*, divided further into sections and series⁵. Whew! One could concentrate on just a *Mammillaria* collection and have a lot of plants.

Preferred Growing Conditions

Mammillarias can be found growing from near sea level to above 8,000 feet of elevation. Like most members of the Cactaceae, they occupy areas typically unsuitable for farming,

Collectors may typically start out with plants in pots and years later move them into the yard as they develop too many heads to be contained any longer. One of the more recent additions to the *Sybil B. Harrington Cactus Gallery* came from a couple from Show Low who brought it back to the Garden, where they had purchased it some 23 years ago.

Mammillarias are enjoyed by people from all over the world. There is even a *Mammillaria* Society in England. You can find the most common plants at any nursery that sells cacti, and once you are hooked, you can search the web at the Cactus and Succulent Plant mall for nurseries that sell the more scarce species. The Garden's bi-annual plant sales offer a large number of *Mammillaria* species, most acclimated to our desert conditions. The fall Plant Sale is scheduled for October 17 - 19, 2014.

To view additional *Mammillaria* photos by Scott visit dbg.org/photos.

References:

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- ²Craig, Robert T., D.D.S., *The Mammillaria Handbook*. Abbey Garden Press, 1945.
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- ⁴Pilbeam, John, *Cactus File Handbook*. Cirio Publishing Services, Ltd., 1999.
- ⁵David Hunt, *A New Review of Mammillaria Names*, published by the British Cactus and Succulent Society, 1987.



DESERT GARDENING RESOURCE CENTER

by Tina Wilson, Director of Education

A major renovation of the classroom in Archer House, completed in March, was made possible by the generosity of Estelle and Paul Lorah. The Lorahs left a significant, unrestricted gift to the Garden that was realized upon Paul's death in 2013. Because they had expressed particular interest in education and horticulture capital projects, the Garden's Executive Committee honored the Lorah's preference by designating a portion of the Lorah's legacy contribution to the classroom project. Now known as the Desert Gardening Resource Center, it is a great updated facility for education and horticulture.

The renovation focused on upgrades that allow education at the Garden to progress from instruction in a traditional teaching space to creating an experiential learning environment for students through technological advancement. The center was fitted with innovative technology, including 15 workstations, an instructor master control station, high definition video projection, a secondary wall-mounted LED display monitor, and a pondering-networking lounge.

For the physical design of the center, we also factored in lighting, color, sightlines, spaces for student collaboration, and overall comfort to create an environment that maximizes multifunctional teaching and learning. With these upgrades and improvements, the Garden can now offer programs that will expand current audiences and increase visibility within the community as a premiere resource of lifelong learning programs associated with the desert environment.

WATCH FOR THESE LEARNING OPPORTUNITIES IN THE NEAR FUTURE



The Digital Darkroom

This program for photography students will complement our existing desert photography classes. It will offer a wide variety of "next step" classes focusing on image editing, processing, and enhancing techniques.



Ask A Gardener and Plant Hotline

Garden guests can work directly with knowledgeable staff and volunteers utilizing computer-based resources to find solutions for their garden and landscape challenges, including plant selection, irrigation, and pest management.



Your Desert Home

These classes and workshops will assist homeowners in creating and maintaining sustainable landscapes in the low desert. Technology-based teaching components will offer additional techniques in plant selection, landscape design, irrigation maintenance and design, integrated pest management (IPM), and plant nutrition, among other topics.



Desert Landscape School

DLS will implement a new instructional design that facilitates blended learning. This environment (also called flipped classroom) will allow students to engage in experiential learning and problem-solving scenarios designed for the program.



Desert Landscape Design Studio

Programs will be offered for landscape professionals who want to expand their skill set in finding and implementing design solutions through computer-aided design (CAD) software, tablets, and hand sketching.

The Garden contracts outside instructors with impeccable credentials that qualify them for teaching and designing curriculum in their areas of expertise. Read more about two such instructors who are highlighted on page 13.

You can learn more about classes and offerings utilizing the Desert Garden Resource Center through the Garden quarterly calendar or visit dbg.org/adultclasses.

Meet the Instructors



Jack Gilcrest – Landscape Design Instructor

Jack was introduced to the natural environment at an early age while growing up on a family farm in the Midwest. He discovered the study of environmental sciences and landscape architecture to be a perfect blend of his interests in nature, art, and engineering. He has undergraduate degrees in Environmental Studies and Landscape Architecture from the State University of New York School of Environmental Science and Forestry, and a Master of Science degree in Environmental Resources from Arizona State University.

His thesis titled “The Effect of Phoenix Open Space Preserves on Residential Property Values” was recognized with a Merit Award in the American Society of Landscape Architects National Awards Program. His study helped gain support for the passage of a bond initiative to fund the establishment of the new 30,000 acre Phoenix Sonoran Preserve. Jack recently received international recognition from the *World Landscape Architecture* publication for the City of Scottsdale’s McDowell Sonoran Preserve Jane Rau Interpretive Trail, an ADA accessible nature trail.

Jack has been a member of the Desert Botanical Garden for almost thirty years and has been an instructor for the Garden’s Education Department for the past several years. He enjoys sharing his knowledge of preserving, designing, constructing, and managing Sonoran Desert natural environments. His educational goal is to instruct and inspire his students to create more appropriate and sustainable landscapes for our urban environments. Jack is also an associate faculty member at Arizona State University’s College of Design for the architecture and landscape architecture programs.

Jack’s favorite plant at the Garden is the creeping devil (*Stenocereus eruca*), which is located adjacent to Webster Auditorium. With accession number 1939-000101, it is the first recorded plant of the Desert Botanical Garden’s living collection and serves as an example of the Garden’s mission of conserving desert plants of the world and exhibiting the many wonders of the Sonoran Desert.



Robert McBride – Photography Instructor

Robert is an award-winning photographer who was bitten by the photographic bug more than 40 years ago, when he became the proud owner of a hand-me-down darkroom setup and a camera prototype featuring one of the first metering systems. While his photographic experience has run the gamut from wedding to commercial, from studio to portrait, from workshop leader to classroom instructor, his passion has always been tied to “bringing the natural world into focus.” His images of nature have been used in numerous magazines, calendars, books, and prints. One highly honored image has been displayed at the Smithsonian Institution. McBride receives immense satisfaction from sharing his experience and passion for photography with students and fellow photography enthusiasts alike.

Teaching at the Garden has provided him the ideal environment for sharing, with like-minded individuals, his love of nature and photography. When talking about himself and the students at the Garden, Robert says that they “think alike,

talk alike and walk the same pathway of experiencing and sharing the natural world.”

Robert is constantly inspired by the passion his students exhibit in their quest for knowledge. “While the basic principles of taking good pictures will endure no matter what the next chapter in photographic history may bring, breakthroughs in the mechanics of photography will always lead to breakthroughs in its art and utility,” he says. He wants every student to leave his classes with both an enhanced appreciation of photography and an insatiable desire to create their own extraordinary images. McBride shares that “the challenge of capturing that perfect image will always have me reaching for that elusive brass ring.”

When asked what his favorite plant in the desert is, he says that “it has to be the saguaro cactus (*Carnegiea gigantea*) as it is the symbol that represents the vibrancy and fortitude that are the Sonoran Desert.”



Searching for the BIG IDEA

Interpretive Master Planning at the Garden

by Elaine McGinn, Director of Planning and Exhibits

if you visited the Garden this spring you may have noticed people on the trails carrying clipboards and talking with visitors. It was not a political or marketing survey... it was an audience research survey about Garden messages and finding out what interests our visitors.

Last fall, Desert Botanical Garden received a planning grant from the Institute of Museum and Library Services (IMLS) to develop an interpretive master plan (IMP). This plan will be a benefit to the Garden as we build the framework for how we communicate with the public about who we are and what we do. The long-term effect of the IMP will be to guide not just how we present content, but also what content is presented in all areas of the Garden.

Interpretive planning is a process that focuses on planning the quality and content of communication between a museum, or Garden, and its visitors. It is an important element in the exhibit development process for a number of reasons, including:

- The value of understanding and caring about the knowledge and opinions of our audiences who are not scientists, curators, or other specialists.
- To be relevant to the Phoenix community, it is necessary that we clearly relate facts about our mission, collections, resources, and activities.
- The importance of providing meaningful and informative experiences for visitors requires that we plan our exhibitions with specific objectives for changes in attitude, behavior, or interest.



We already have a high quality, memorable visitor experience. The IMP does not aim to change that, but rather to maximize the opportunity to make deeper connections with our community. The result of this two-year process will give us a fully developed interpretive master plan that will inform and provide:

- A common sense of identity and purpose.
- An improved understanding of our audiences, including stakeholders.
- A focus for the development of all education and interpretive elements and programs, such as permanent and temporary signs, exhibits, guided tours, seasonal/special events, curricula, and staff/volunteer training.
- A guide for plant acquisition and display to support the Garden's communication goals.
- A method for evaluating the outcomes of visitor interactions with the Garden.
- A documented practice to share with other botanical gardens and natural history institutions.

As part of the IMLS grant, we have engaged the services of two nationally recognized consultants in interpretive planning and audience research. Judy Rand, of Rand and Associates, and Jeff Hayward, of People, Places & Design Research were selected because of their extensive and proven track record in working with museums, gardens, aquariums, and other cultural institutions to develop comprehensive and meaningful interpretive plans.

In October, a core project team of staff and advisors met for four days with Rand and Hayward to set the vision and goals for the Interpretive Master Plan. Those workshops led to idea development for interpretative messages and topics to be tested with target audiences to further develop those ideas. In January we began our first phase of audience research, learning more about our visitors by asking questions about who they are, why they come, how we can improve the visitor experience, and how they perceive the Garden.



The impact of the IMP to our strategic goals will be a stronger and more integrated, comprehensive approach to planning at all levels, bringing together the physical master plan, collections plan, strategic plan, and interpretation. The IMP will provide the foundation that will improve our ability to develop relationships with visitors through interpretation that is focused, clear, and consistent. It is our goal to create experiences that motivate and inspire our visitors to have stronger connections with nature, to understand the relationship between plants and people, and to increase their appreciation for and desire to take actions to conserve the natural world.

75th ANNIVERSARY HIGHLIGHTS

The Garden's twelve-month celebration of the anniversary year culminated on February 13, 2014, with the *Celebrate 75 Luncheon*. Our dynamic founder, Gertrude Divine Webster, served as Mistress of Ceremonies (brilliantly brought to life by actress Patti Hannon). Jacquie and Bennett Dorrance, Chair of the Anniversary Cabinet, and Phoenix Mayor Greg Stanton welcomed guests. Garden Director Ken Schutz recognized special anniversary honorees. Guest speaker Dr. Lattie Coor delighted guests with his reflections about the Garden. With his permission, we share excerpts from Dr. Coor's talk as reported by Carol Schilling:



Phoenix Mayor Greg Stanton (l) with Ken Schutz (r).



Dr. Lattie Coor with his wife, Elva Coor.

~ *Arizonans have come to love and appreciate their Sonoran Desert in recent years, but all along the Garden cherished and displayed the desert's floral treasures for those who would pay attention.*

~ *Historically, Arizona's identity focused on farming, mining, and a healing climate. The presence of the Sonoran Desert was unrecognized even in Arizona's Great Seal or in the school-taught lessons of Arizona's 5 C's (copper, cattle, citrus, cotton, and climate), but the Garden has been making people aware of the desert and its beauties through the decades.*

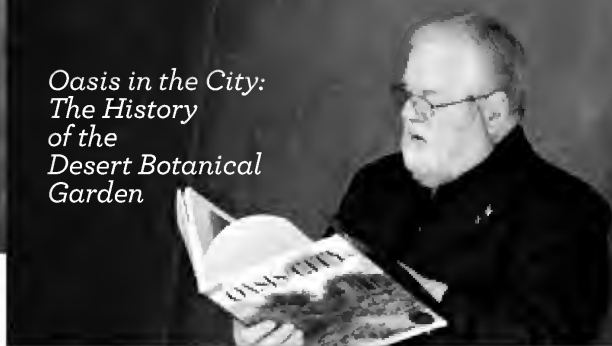
~ *The Garden has given us the Sonoran Desert spiritually, conceptually, functionally in a visible and vibrant way that has enabled us to understand it and to embrace it as something that is central to our core identity as a place and a people. It has been influential in educating us, informing us, and enticing us to experience and appreciate the flora of this magnificent desert.*

~ *In addition to being where we live, the desert is who we are. As the biologically most diverse desert in the world, it not only provides us a magnificent, unique setting, it also offers us a distinctive signature as our identity—a desert people.*

Dr. Coor was president of Arizona State University for 12 years, retiring in 2002. He is a founder of the Center for the Future of Arizona and serves as its chairman and CEO. The Center sponsored a Five Communities competition that encouraged the founding of the Central Arizona Conservation Alliance, a Desert Botanical Garden-led coalition of scientists, land managers, educators, community liaisons, and conservation-based non-profit organizations committed to the ecological and recreational sustainability of the mountain park preserves in and around the Phoenix metropolitan area. Dr. Coor believes the Alliance will become a model for other desert cities in the world.

We invite you to visit dbg.org/speech to read Dr. Coor's Anniversary Luncheon talk in its entirety.

Oasis in the City: The History of the Desert Botanical Garden



The second edition of the Garden's history book *Oasis in the City: The History of the Desert Botanical Garden*, pictured here with Pete Morgan, made its debut at the Celebrate 75 Luncheon. It is now available for purchase at the Garden Shop and online at gardenshop.dbg.org.



Thanks to our stellar 75th Anniversary Cabinet Members and generous supporters, \$7.4M has been contributed as of May 1, 2014.

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By the Numbers

FOR CALENDAR YEAR 2013

The Desert Botanical Garden's 2013 Annual Report will be available online at dbg.org/annualreport after June 12, 2014. We have included an excerpt of the Annual Report's "By the Numbers." Please take a moment to read more about 2013 at dbg.org/annualreport.

Attendance 439,749

Membership Households 30,934

Horticulture

Acres at Desert Botanical Garden 140

Acres Under Cultivation 55

Attendance at Biannual Plant Sales 11,432

Landscape & Gardening

Desert Landscape School Graduates 2013 35

Desert Landscape School Graduates Total 1,286

Plant Hotline Questions Total 1,856

Response to Calls 858

Response to Emails (including Facebook) 948

Live Facebook Chat 50

Ask a Gardener Visitor Interactions 1,267

Living Collection

Total Accessioned Plants 24,554

Total Accessioned Seeds 4,221

Total Number of Species 4,262

New Accessions Added 2,110

New Species Added 68

Rare and Endangered

Total Seed Accessions of Rare/Endangered Species 1,767

Number of Rare/Endangered Species 394

Herbarium

Total Specimens 74,250

Staff Publications 10

Schilling Library

Books 9,590

Botanical Prints 600

Journal and Newsletter Titles 540

Maps 2,376

Education and Tours

School Tour Participants 23,343

Children in Education Programs 417

Children in Seedlings Preschool Program 161

Girl Scouts 1,475

Adult Education Class Participants 3,193

Volunteers

Individual Volunteers 830

Individual TEEN Volunteers 24

Community Organizations and Corporations 16

New Volunteers 108

New TEEN Volunteers 11

Total Active Hardy Perennials (10+ years) 129

Total Hours Contributed 63,598

Total TEEN Hours Contributed 397

Awards for 100+ Hours in 2013 243

Volunteer Length of Service Awards

500 Hours 24

1,000 Hours 20

2,000 hours 10

3,000 Hours 9

4,000 Hours 3

5,000 Hours 4

6,000 Hours 2

7,000 Hours 1

Docent Interpreter Interactions With the Public 175,204

Staff

Full-time 90

Part-time and Seasonal 164



Garden Awarded a Collaborative Five-year Grant

Kevin Hultine (Plant Physiologist, Desert Botanical Garden), Gerard Allan, Catherine (Kitty) Gehring, Kevin Grady, Thomas Whitham (Northern Arizona University), and Sam Cushman (U.S. Forest Service) were recently awarded a collaborative five-year grant from the National Science Foundation's Macrosystems Biology program totaling \$2.5 million (\$346,000 to the Garden).

The study will focus on how climate change and the spread of non-native plant species impact Fremont cottonwood (*Populus fremontii*) and the biotic communities associated with this native riparian tree. Fremont cottonwood is a foundation species in desert riparian habitats, which support unique and diverse communities of organisms. Loss of cottonwoods, and diminished genetic exchange among fragmented cottonwood populations may make cottonwoods and their dependent communities especially vulnerable to climate change and the presence of exotic species such as salt cedar.

Results from the study will have important implications for managing riparian forests in the southwestern United States. Recognized as hot spots of biodiversity that support many species, including many that are threatened and endangered, cottonwood communities are rapidly vanishing (fewer than 3% remain).

Ottosen Entry Garden Receives National Recognition in Design

The American Society of Landscape Architects (ASLA) presented the General Design Honor Award to Spurlock Poirier and the Desert Botanical Garden for Ottosen Entry Garden.

This prestigious award recognizes site-specific built works of landscape architecture based on the quality of design and execution, design context, environmental sensitivity and sustainability, and design value to the client and other designers. The award ceremony took place in Boston at the ASLA annual conference in November.



ISA Certification Program Nomination

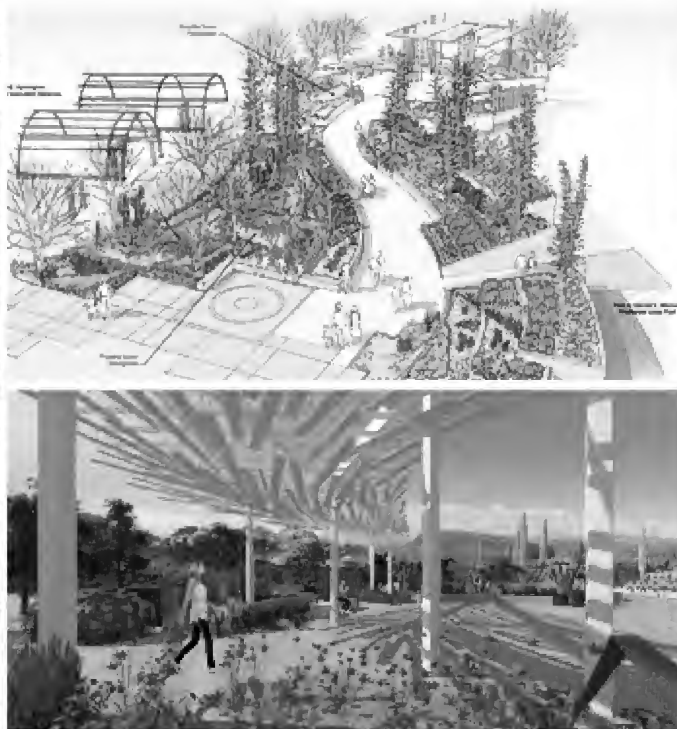
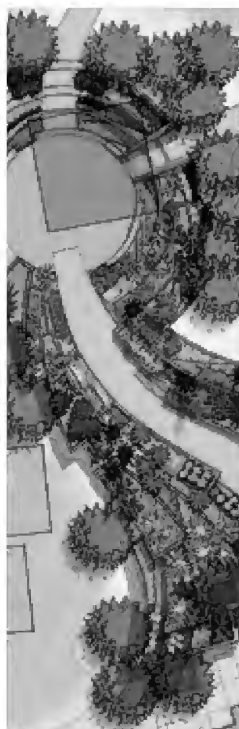
Congratulations to Luana Vargas, Program Director for Adult Education, who was elected to the International Society of Arboriculture (ISA) Certification Board.

The Certification Board serves as an independent body within ISA, responsible for the development, review, evaluation, and administration of all policies and procedures related to the ISA Certification Program. To date, ISA has certified over 27,000 arborists in 14 countries, including the U.S., with six arborists certified at the Desert Botanical Garden.

Lewis Desert Portal and Desert Terrace Gardens Construction to Begin

On June 2, the Lewis Desert Portal and Desert Terrace Gardens will begin construction.

Construction should be completed by late November, with an official ribbon cutting in January 2015. Located between the *Ottosen Entry Garden* and the *Center for Desert Living Trail*, these projects will require us to close segments of the *Desert Discovery Trail* and provide alternate entrances and exits. Updates on construction progress will be posted on the Garden's Website—we invite you to check dbg.org before you visit so that you are aware of current changes.



Garden Hosts 33rd IOS Congress

The Desert Botanical Garden hosted the 33rd Congress of the International Organization for Succulent Plant Study (IOS) from April 8-11. The IOS is a non-governmental organization that promotes the study and conservation of succulent plants. Participants from 10

countries, including Mexico, South Africa, Guatemala, the United Kingdom, Italy, Brazil, New Zealand, Gibraltar, and Oman, delivered 32 presentations on their research on a variety of topics. Garden scientists Shannon Fehlberg, Wendy Hodgson, Kevin Hultine, and Andrew Salywon made presentations on their research. Garden staff gave tours of the greenhouses and Fred Kattermann presented a detailed history of the South American cactus collection that he recently donated to the Garden. Staff scientists and Congress participants took part in an opening reception on Ullman Terrace and a closing banquet on Boppart Courtyard. They also enjoyed the beauty of the Garden and the spectacular Chihuly exhibit during their visit. The Garden has a long history of association with the IOS, having hosted previous congresses in 1992 and 2002.

Photo Credits

Page 2 Ken Schutz - Jim Poulin
 Page 2 View from *Desert Discovery Trail* - Adam Rodriguez
 Page 3 Strawberry cactus, *Echinocereus brandegeei*, growing under a creosote bush - Adam Rodriguez
 Pages 4-7 Fred Kattermann article photos - Raul Puente-Martinez
 Page 4 Collecting fruits of *Maihueniopsis ovata*, Banos del Toro, Chile - Fred Kattermann

Page 8 Botanical illustration courtesy Schilling Library Archives, Desert Botanical Garden
 Pages 10-11 *Mammillaria* article photos - Scott McMahon
 Page 12 Desert Gardening Resource Center - Adam Rodriguez
 Page 13 Garden Instructors - Dick Trelease
 Page 14 Garden staff interviewing visitors - Renee Immel
 Page 15 *Echinopsis candicans* - Adam Rodriguez
 Page 15 Survey taker and visitors - Kim Pegram
 Page 16 Celebrate 75 Luncheon - Ben Arnold

Page 18 *Ottosen Entry Garden* - Adam Rodriguez
 Page 18 Luana Vargas, Program Director, Adult Education - Dick Trelease
 Page 19 Renderings by Studio Outside and 3.fromme DESIGN
 Page 19 IOS Congress participants - Steve Emrick
 Back cover: Flashlight Tours - Adam Rodriguez
 Correction: In the spring *Sonoran Quarterly*, March 2014, Volume 68, No. 1, on page 5, the correct name is Table Mountain.



SONORAN QUARTERLY

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The Desert Botanical Garden Mission

The Garden's commitment to the community is to advance excellence in education, research, exhibition, and conservation of desert plants of the world with emphasis on the Southwestern United States. We will ensure that the Garden is always a compelling attraction that brings to life the many wonders of the desert.



WiFi Zone

FREE WI-FI is available in five locations within the Desert Botanical Garden: the area in front of Admissions, Ottosen Entry Garden, Boppert Courtyard, the Center for Desert Living Trail, and Ullman Terrace.



City of Phoenix

PHOENIX OFFICE OF ARTS AND CULTURE

Partial funding provided by the Phoenix Office of Arts and Culture through appropriations from the Phoenix City Council.

Flashlight Tours

Thursdays and Saturdays

May 24 - August 30 / 7 - 9 p.m.

Included with membership or paid Garden admission.

Bring a flashlight and join us for an evening of adventures!

Flashlight tours are a sensory experience where you will see, hear and feel the desert night. The self-paced stroll along the Garden's trails to a variety of discovery stations is perfect for families and children of all ages.

For additional information call **480 941.1225** or visit **dbg.org**.



Birthday Parties

Looking for an adventurous and educational place for your child's birthday party this summer?

Recommended for children ages four and up. Parties offered on Thursday and Saturday nights only, May 24 - August 30.

For pricing and availability, call **480 481.8159**.



Desert in the Dark

What is our desert like in the dark? Scouts will experience the Sonoran Desert at night while learning about the stars and nocturnal animals through this self-guided program. *Available select dates June through August.*

All levels of Girl Scouts are welcome.

Program fee: \$9 / scout and \$9 / chaperone

For additional information or to register, please visit **dbg.org/girlscouts** or call **480.481.8121**.



SONORAN QUARTERLY

FOR MEMBERS AND FRIENDS OF THE DESERT BOTANICAL GARDEN

PHOENIX, ARIZONA SEPTEMBER 2014, VOLUME 68, NO. 3





The Vital Nature of Water

In this issue of *The Sonoran Quarterly*, we take a look at water from a variety of perspectives.

Because we are dedicated to leading by example, we are pleased to share our understanding of how and why water conservation is so important to the health of our community.



In several articles, you will read about the very practical steps we are taking at the Garden to harvest and conserve water. Plant physiologist Dr. Kevin Hultine's feature story describes his research into the effects of drought and climate change on the evolution of desert plants. And in an article entitled "Fish Out of Water," you will read about the art that Dr. Joe McAuliffe creates from the fish he catches in Arizona's waterways.

What ties these stories together is the vital nature of water. Whether from the sky, the canals, or the aquifer, every drop is precious and worth every effort to keep the water supply clean, safe and plentiful. Because we are dedicated to leading by example, we are pleased to share our understanding of how and why water conservation is so important to the health of our community.



As I write this, the monsoon season is just beginning and I have great hopes for frequent and generous rainfall. By the time you read this in September, you will know if my wishes came true! Either way, all the plants at the Garden will be happy and healthy, anticipating cooler weather (just as we are), and waiting to delight you when you visit this fall.

Ken Schutz
The Dr. William Huizingh Executive Director

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The Sonoran Quarterly

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In Appreciation

On the Cover

Recirculating water feature in the Stardust Foundation Plaza, generously funded by the Columbine Garden Club, designed by Steve Martino, landscape architect and fabricated by Larry Kornegay. The base is made from recycled materials. Photo by Adam Rodriguez.

Back Cover

Fall Plant Sale
October 10 - 12

Garden Members Preview:

Friday / October 10 / 7 a.m. - 5 p.m.

Open to the General Public:

Saturday / October 11 / 7 a.m. - 5 p.m. AND

Sunday / October 12 / 9 a.m. - 5 p.m.

No admission charge to enter Fall Plant Sale.



Does Stem Size Matter in a CHANGING CLIMATE?

by Kevin Hultine, Plant Physiologist

Saguaros and other large cacti are, without question, some of the most unusual members of the plant kingdom. Everything about them—their external form, internal anatomy, and even inner physiological and biochemical workings—is so very different from that of “typical” plants. What we want to know is whether these unique characteristics will factor into their survival in a changing climate.

Predicted climate changes in the desert regions of North America may make life more difficult for water-storing cacti. Temperatures are expected to rise and precipitation may become more unpredictable than it already is. Rising nighttime temperature is of particular concern because of the peculiar form of photosynthesis used by cacti: they take in carbon dioxide at nighttime, which is best accomplished at somewhat cooler temperatures. The urban heat island effect will magnify any future warming in Phoenix, where nighttime low temperatures are already about 10° F higher than they were in the 1950s. The growth and survival of giant columnar cacti may be significantly altered by such changes.

Looking at Stem Variations

Although cacti all share certain characteristics, like a capacity for storing water, there is much variation in anatomical features among different species. Some species, like saguaro (*Carnegiea gigantea*) and cardón (*Pachycereus pringlei*), are heavy-bodied, barrel-chested giants. Others, like the Christmas cholla (*Cylindropuntia leptocaulis*), must store all their water in stems no thicker than a pencil (Figure 1). Shapes and sizes of the nearly 2,000 different species of cacti range between these two extremes.

As a scientist who studies the evolutionary biology of plants, I am fascinated by the ways that these kinds of anatomical differences affect how different species of cacti respond to conditions in hot, dry environments. It is common knowledge that cactus species with different shapes and sizes are often found together in the same environments. For example, thin-stemmed chollas (genus *Cylindropuntia*) grow together with giant saguaros. Are there certain advantages and disadvantages

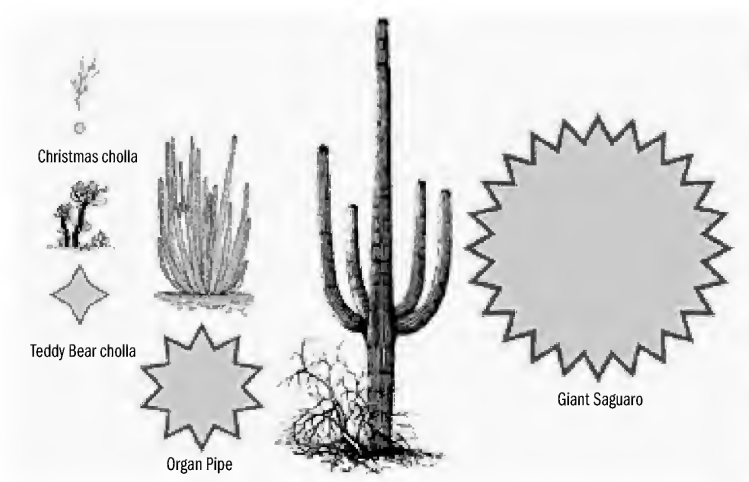


Figure 1 – Diagrammatic cross sections showing the different stem shapes of common cacti plants including Christmas cholla (top left), teddy bear cholla (inside left), organ pipe (bottom left) and giant saguaro (far right). Christmas cholla and saguaro represent the opposite extremes in stem thickness, surface area and volume.



Cactus plants come in many shapes and sizes. The shape of the stem may yield clues on how a cacti species will perform under future climate change.

under a given set of climatic conditions for being built like a saguaro relative to being built like a small cholla? Furthermore, if those points can be identified, could this information help us predict how dissimilar species will respond to changes in climate?

Stems versus Leaves

To better understand how some cactus species might be more sensitive to climate change than others, let's compare cactus stems to the leaves of typical leaf-bearing plants.

Leaves of different plant species vary considerably in size, shape, and thickness. Research in plant physiology has shown that certain leaf characteristics can be used to predict how a given plant might function in certain conditions. For example, the ratio of a leaf's surface area relative to its mass (or thickness) affects how much a plant gains through photosynthesis (use of energy from sunlight to create sugars from water and carbon dioxide).

For leaves from two different species that have the same surface area but different masses, thin leaves – those with a high surface-to-mass ratio – yield a higher net gain from photosynthesis than do thick leaves with a lower surface-to-mass ratio. This is because the construction of a thicker leaf requires a greater amount of materials (i.e., it has a higher fixed cost) than that required to make a thinner leaf. Despite this seeming advantage, thin leaves are not always the best performers. Plants with thicker leaves are often less vulnerable to stress caused by drought or other factors because they are much less prone to tissue damage from dehydration.

Because numerous plant characteristics affect plant responses to moisture availability and temperature, rapid climate change may expose some plant species to conditions that are unsuitable for their growth, reproduction, and survival.

Explaining the S-V Ratio in Cacti

Cactus stems share similar characteristics with leaves. Just like leaves, cactus stems use energy from sunlight for photosynthesis, but it occurs only in the relatively thin, green-colored external layer of a cactus stem, and not in the deeper, internal succulent tissues. The ratio of the amount

of green surface area compared to the volume of internal tissue affects the plant's net gain through photosynthesis.

The thin stems of the Christmas cholla, for instance, yield a higher net gain from photosynthesis than do the thicker stems of the saguaro. This is because the amount of green photosynthetic tissue is large relative to the fairly small volume of non-photosynthetic internal tissues. In other words, it has a high surface-to-volume (S-V) ratio, analogous to the high surface-to-mass ratio of a thin leaf in comparison to a thick, leathery leaf.

Despite the higher net photosynthetic gain possible in the thin-stemmed Christmas cholla, the thick-stemmed saguaro, with a corresponding lower S-V ratio, can store more water and nutrients. This storage enables it to survive during longer hot and dry periods.

Among all columnar cacti and cholla species, there is about a hundred-fold variation in surface to volume ratios of stems. This remarkable range in S-V ratios of cactus stems should yield different kinds of performances in different environmental situations. High maximum stem growth rate should occur in plants with high S-V ratios. We find, however, that plants capable of rapid growth may be more sensitive to climate-related stress since the smaller stems will be the first to exhaust their supply of stored resources. In other words, the vulnerability of cacti to climate change can be predicted to some degree by the S-V ratios of their thin stems. Climate change models predict significantly warmer temperatures and increased drought intensity across the deserts of North and South America in the coming decades. The Sonoran Desert, in particular, is expected to



Net gains through photosynthesis are higher in thin-leaved cottonwood (upper left) than in thick, stout needles of pinyon pine (upper right). Similarly, thin-stemmed *Cleistocactus* (lower left) are capable of higher net gains through photosynthesis than the massive-stemmed cardón (lower right). Photos by Kevin Hultine.

experience some of the largest increases in air temperature and drought occurrence on the planet over the next 80 years. How a species will respond to changes in climate is difficult to determine. However, given the potentially important implications of S-V ratios of cactus stems, we may be able to establish testable predictions for how various cacti species will respond to climate change.

A Treasure Trove of Research Potential

The Desert Botanical Garden is home to the national collection of cactus and agave families within the North American Plant Collections Consortium (NAPCC) of the American Public Gardens Association (APGA). The living collections at the Garden include 1,319 taxa of the family Cactaceae, or 74% of the total taxa in the family.

The collection includes some of the largest of all columnar cacti such as giant saguaro, giant cardón (native to northern Mexico), Argentine cardón (*Echinopsis terscheckii*, native to Argentina and Bolivia) and the pasacana tree cactus (*Echinopsis atacamensis*, native to Peru, Bolivia, and Ecuador), along with some of the smallest of these plants such as Christmas cholla and pencil cholla (*Cylindropuntia ramosissima*). In other words, the living collection of cacti spans the full spectrum of stem S-V ratios found in columnar shaped cacti and cylindrical stemmed cholla species in the wild. This exceptional collection of plants in a common setting provides a rare opportunity to explore the different characteristics associated with variation in stem S-V ratios of cacti.

Additionally, the Desert Botanical Garden sits right smack in the middle of the urban heat island of Phoenix, which means that the temperature at night is much warmer than the places of origin for most of these plants. Therefore, many of these plants might already be living under conditions analogous to those that could occur in their native habitat under future climate change. Given these factors, the living collection provides an excellent opportunity to study the impacts of heat stress on various species with stems of very different shapes and sizes.

A Cool Approach to Measuring Heat Stress

So how does one measure water and heat stress in cacti? My colleagues from the Universities of Arizona and Wyoming and I are using a cutting edge approach that relates the chemical composition of cactus spines to the stress experienced by the cacti during the time when the spines developed.

Our approach takes advantage of the fact that new cactus spines are produced only at the growing tips of stems. Once the spines are produced, they are usually retained for many years or decades as the plant continues to grow taller. This means that the youngest spines are at the very top or apex of the plant and the spines are progressively older towards the base of the plant. Our earlier research shows that it takes only a few days to a few weeks for each spine to grow. Once a spine ends its growth, the chemical composition during the time that it was developing is retained within the dry spine.

Certain chemical properties (specifically the isotopic weights of carbon, oxygen, and hydrogen atoms) in spine tissues vary depending on the environmental conditions the plant experienced during the spine's growth (Williams et al., 2014). We are tracking these stable isotope signatures recorded in the spines of more than 50 columnar cactus and cholla species with a diverse range of stem shapes and sizes in the Garden's living collections. We have found evidence that supports our prediction that larger-stemmed plants like saguaros may be less affected by extreme heat compared to smaller-stemmed species simply because their thicker stems can store more water and other resources needed to cope with the stressful conditions. Our ongoing research of the chemical composition of cactus spines at the Garden may yield important clues as to which species will be most vulnerable to future climate changes.

The Sonoran Desert as a Region-Wide Outdoor Laboratory

The Sonoran Desert has a rich biological diversity and broad variability in temperature and annual rainfall. As home to many cactus species, the Sonoran Desert offers a unique opportunity to study relationships between climate and the shapes and sizes of cactus stems. Again, my colleagues from the University of Arizona and the University of Wyoming and I are studying the impacts of climate variability on the growth and physiology of many columnar cactus species throughout the Sonoran Desert, including the iconic saguaro.

Measuring growth in these slow-growing plants is a challenge, but we have found a clever and simple way to do so. As mentioned earlier, new spines are produced only at the very tips of stems. We accurately measure each year's growth by painting the newest spines at the very tip of the stem and return the following year to measure the amount of stem growth that occurred since the spines were painted.

Combined with other, more sophisticated measurements of plant stress, the stem growth measurements provide a picture of how various cacti respond to climate conditions. We are currently measuring stem growth in 180 individual cactus plants of five different species, including saguaro, cardón, organ pipe (*Stenocereus thuberti*), senita (*Lophocereus schottii*) and sour pitaya (*Lophocereus gummosus*). Research sites throughout the Sonoran Desert include locations as far south as Bahía Kino in Sonora, Mexico, and as far north as Cave Creek, Arizona. We plan to expand these surveys to include many more locations and species so that we study the widest possible range of climate conditions and variation in cactus stem anatomy dimensions.

Matching Research with Conservation Priorities

We anticipate that our continuing studies of the growth and physiology of cacti will lead to valuable insight into the responses of these iconic plants to climate change, drought, and other stressors.

Our observations should be highly relevant for efforts to select traits in cacti and other succulent plant species that are now being tested for potential food crops and biofuels, and for conservation and management of fragile desert ecosystems. For example, if some cacti are used for agricultural applications, especially in dryland agriculture, the tradeoff in maximum growth versus stability under variable drought conditions would be a key factor in determining which cactus species would provide highest yields.

Finally, conservation management of wildland desert habitats that include natural populations of columnar cacti should account for potential vulnerabilities of these important species and the diverse wildlife communities they support in light of anticipated climate changes.

References

Williams, D.G., K.R. Hultine, and D.L. Dettman. 2014. Functional trade-offs in succulent stems predict responses to climate change in columnar cacti. *Journal of Experimental Botany* doi: 10.1093/jxb/eru174.



Dr. Hultine's position is supported by many generous donors who contributed to the Tending the Garden Campaign. His knowledge and expertise continues to enhance the Garden's scientific research efforts to inform conservation management of desert habitat.



Scientists from the University of Wyoming and the University of Arizona measuring the height of a giant saguaro in the Kofa Mountains near Quartzsite, Arizona. Photo by Kevin Hultine.



The interval between the two sets of painted spines shows how much a small saguaro grew over a five year period. We measure this growth interval to determine average yearly growth over the interval of study. Photo by Nathan English.

THOSE DROPS IN THE BUCKET DO ADD UP

Getting Around the Drought

by Brian Kissinger, Director of Horticulture

Arizona has been parched for years, along with the rest of the Southwest. The recent drought has been prolonged by a large ridge of high pressure that has stuck around the near Pacific for way too long. But there is hope that this will change in the near future. I asked some of the Garden staff for the latest outlook from their department's perspective.

Canal Water Project

MaryLynn Mack, deputy director, offers an update on the success of the Canal Water Project.

The Canal Water Project was introduced in the September 2013 *Sonoran Quarterly* as an innovative new way for the Garden to conserve water, reduce operating costs, and provide a healthier alternative for plants requiring supplemental irrigation.

With help from Arizona Community Foundation and Salt River Project, the improvement to the Garden's water system was successfully completed. A new pump system with split irrigation lines (one each for potable city water and nonpotable Crosscut Canal water) has been in operation for the past eight months.

The canal water is supplied to the Garden at a significantly lower cost than potable water. That, coupled with a decrease in potable water usage, will result in the \$350,000 project paying for itself in five years.

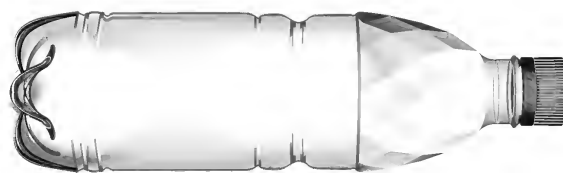
A snapshot of water use:

Potable Water		Canal Irrigation Water
Oct 2012	3,324,112 gallons	0 gallons
Oct 2013	491,436 gallons	1,427,229 gallons
October 2012 water bill: \$22,527.41		
October 2013 water bill: \$ 9,459.12		
April 2013	2,169,000 gallons	0 gallons
April 2014	602,888 gallons	1,609,704 gallons
April 2013 water bill: \$16,150.85		
April 2014 water bill: \$10,483.63		

Through April 2014, the Garden has seen a total savings of over \$35,000.*

Although numbers cannot be used to determine plant health and condition, Director of Horticulture Brian Kissinger has seen a difference in the soil. "The soil is becoming less alkaline and saline—this is always the best scenario for optimal plant health." As the Desert Botanical Garden continues to create permanent exhibits and add to its world-renowned collection, drawing from the Crosscut Canal will result in continued operational savings and a beautiful Garden for the community. This means enhanced programs in education, research, and conservation and a stronger legacy for the Garden and for Arizona.

*There will be less potable water usage and more savings during the hot summer months when there is not a major exhibition, resulting in an average savings of \$75,000.



Think Before We Consume

Nina Avila, children's education manager, describes how the Desert Botanical Garden is creatively working to conserve water and still be a beautiful place to visit with amazing water-smart plants.

Using less water when we wash our cars and irrigate our yards can help to conserve a natural resource, but there are other, less obvious remedies. Think about plastic and other man-made products we use every day. These items require millions of gallons of water to make, clean, and process before arriving on store shelves. Consider a bottle of water. It takes at least twice the amount of water to produce the plastic and paper label as the amount of water inside the bottle. The best way to combat this overuse of water is to reuse and repurpose materials before they travel to landfills and recycling facilities.

The Desert Botanical Garden is taking steps to encourage reuse through the installation of water bottle filling stations along its trails. The first of many is located on the southwest corner of Archer House on the *Center for Desert Living Trail*. Each time a bottle is filled, the station informs the user of how many water bottles have been saved. Remember, the number of plastic bottles saved is equal to more than the amount of water that goes inside. Look for more bottle filling stations along the trails in coming seasons.

Another service used on a daily basis with hidden water costs is electricity. Steam (water as vapor) is used to rotate turbines and generate electricity in fossil- and nuclear-fueled power plants. When a light is on and electricity is used, so is water. The Garden is taking steps in partnership with Relumination, LLC, an energy-efficient lighting solutions company, to update the majority of interior and exterior lighting with LED lamps. These updates are expected to reduce electricity consumption by 74%, which equates to 247,931 kWh of electricity each year.

Join the Garden's efforts by changing how you consume water-dependent products. Together, we can save more of the natural resources that inhabit the Sonoran Desert.



Harvesting Rainwater

Raul Puente Martinez, *curator of Living Collections* and **Einav Henenson**, *former horticulture staff*, report progress in creating a rainwater harvesting project within the Garden.

Here in the Garden we use a considerable amount of water to irrigate more than 50,000 plants in the living collection. Reducing our water consumption is one of the easiest ways to reduce our ecological footprint and move the Garden towards sustainable water consumption. One way of doing this is to harvest rainwater, capturing it on site instead of letting it get lost as runoff.

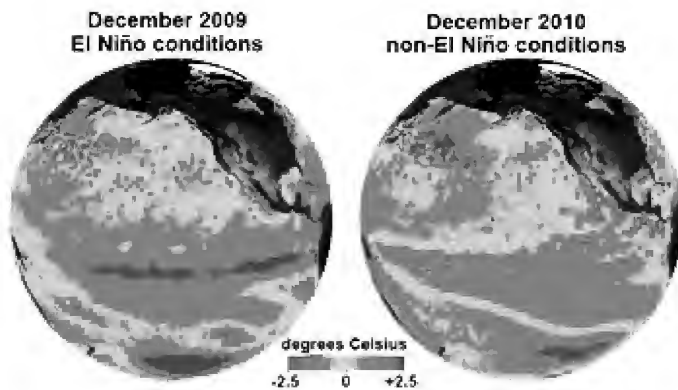
To accomplish that, we are redesigning the drainage system in the parking lot. The old drainage system was designed to send the water away from the parking lot to a retention basin, carrying asphalt and other pollutants with it.

The new design will incorporate about twenty bio-retention basins that will collect and spread rainwater in the medians. This creates many benefits: the plants utilize the water and cleanse it of contaminants; less water leaves the property,

thus we need to bring in less water for irrigation; the quality of water leaving our property is improved; and parking spaces that were once flooded are free again for the visitors.

The Garden's main parking lot has the potential to capture about 878,000 gallons of rainwater per year. The average rainfall in the Valley is approximately seven and a half inches. The potential throughout the total parking lot area is 1,838,000 gallons, an amount that could easily fill three Olympic pools with water! By showing visitors simple methods for harvesting rainwater that they can apply in their own backyards and by communicating the importance and benefits of rainwater harvesting, we contribute further to water conservation.

Our vision for the Garden's future is to be sustainable when it comes to water (and other resources, of course). This will not be an easy task, but if we could capture and use most of the rain that falls on our property and reduce the majority of irrigation inefficiencies, we will get very close to achieving sustainable water consumption. Our goal is that, in the near future, the Garden will provide the knowledge and examples that will help the larger community to achieve better water-using lifestyles.



Return of El Niño?

Dr. Joe McAuliffe, director of research, conservation and collections answers the question, "Is El Niño returning?"

We are thankful for the new supply of high-quality, lower cost irrigation water from the SRP's Crosscut Canal, but nothing beats the quality and price of water delivered straight from the sky, free of charge. For the past 15 years though, annual rainfall throughout the entire Sonoran Desert region has been far below average. That may change this winter and spring with the possible arrival of El Niño, a recurring climate pattern that generates more winter-season precipitation in our region as well as along the Pacific coast of South America. The Spanish name for this phenomenon, originally coined by Peruvian fishermen, means "the Christ child" and refers to its typical onset on the coast of Peru around Christmas time.

El Niño conditions usually recur every two to seven years and are linked to oscillating patterns of winds and water temperatures in the southern Pacific Ocean region. Normally, strong trade winds blowing from east to west across the Pacific Ocean produce warmer surface water temperatures in the western Pacific. Occasional weakening of these winds causes a surge in surface water temperatures of the eastern Pacific. These warmer waters yield more water vapor to the atmosphere, and ultimately, more precipitation along coastal South America all the way north to the southwestern United States.

Measurements of atmospheric pressure, surface water temperatures, ocean levels, and wind speed in different parts of the southern Pacific region are used to predict the likelihood that El Niño conditions will develop. Forecasts in May 2014 by the Climate Prediction Center of the National Oceanic and Atmospheric Administration give a more than 75% chance that El Niño conditions will develop by this fall to winter season. The last El Niño occurred in the winter of 2009-2010, so its arrival this winter would not be too surprising.

If El Niño conditions do develop, we can look forward to a spectacular show of desert wildflowers in late winter/early spring. Produced by the abundant rains, the peak bloom in southwestern Arizona usually occurs during March, which never fails to surprise and delight residents and visitors.

Making Choices for Conservation

With the climate going through such change, it seems droughts and floods are more severe and more frequent. We need to be prepared for these changes today as well as for tomorrow. There are many lessons we need to learn to be better stewards of this home we call Earth.

Don't feel guilty about your usage, reduce it! Phoenix and its surrounding cities could learn from other places, such as Tucson, about making smart landscape choices. Removal of thirsty lawns and replacing them with lush desert landscaping is one such option. You can have a stunningly beautiful landscape for about a third of the water that a lawn requires.

The Desert Botanical Garden provides a great opportunity for purchasing water-smart plants twice a year at the spring and fall plant sales. A huge selection of desert-adapted plants is available in one location. Take advantage of the next plant sale on October 10 - 12 (see back cover for details) to start the transformation of your yard. Garden staff will be on-site to answer questions and help you choose the best plants for your home's landscape.



Fun Ways to Teach Good Water Habits

by Nina Avila, Children's Education Manager

Plants and animals have adapted to survive in the distinctive environmental conditions of the Sonoran Desert. Low annual rainfall, a high rate of evaporation, and extreme temperature fluctuations have influenced the way desert organisms look and function. These adaptations allow plants to efficiently collect, contain, and conserve water in such a dry climate.

Humans also inhabit the desert and make choices that can impact the amount of water available to other organisms. If the desert is an environment we want to preserve, then it is important to teach the young people in our lives today how to wisely use this vital resource. A simple choice like washing your family pet outdoors will provide water to your landscape instead of sending it down the drain. Or when an ice cube lands on the floor, place it next to a plant instead of in the sink. To learn more tips for teaching your family good water-using habits, visit www.wateruseitwisely.com.

An enjoyable and healthy way to encourage water-saving habits is to connect young people to their local environment.

Spending time with them outdoors, observing the landscape together, and investigating organisms that live there help to foster that connection. As you spend time together outside, you will help your loved ones to develop a lifelong appreciation for plants, animals, and natural resources.



Here are some fun ways to help you get started:

Connect at Home

- Install a rain gauge outside of your home and record regular readings.
 - Explore a pond in your neighborhood or favorite local park.
 - Experiment by timing how long it takes for different amounts of water to evaporate.
 - Observe the different shapes and sizes of leaves in your neighborhood and research why they might be so small.
- Register for the Garden's free online learning program, *Digital Learning* (dbg.org/digitallearning), and learn about the desert together as a family.

Connect at the Garden

- Visit the *Desert Oasis* on the *Plants and People of the Sonoran Desert* trail.
- Look for the children's *Mud, Mud, Glorious Mud* education program in the spring Garden calendar.
- Ask for a plant bingo sheet at any Garden admission window and search for plant adaptations along the trails.
- Visit the *Center for Desert Living* trail and learn about saving water in your home landscape.
- Check the Garden's website or calendar for programs that explore seasonal desert ecology topics.
- Refill your family's water bottles outside of Archer House at the new bottle filling station.



The Saguaro Initiative

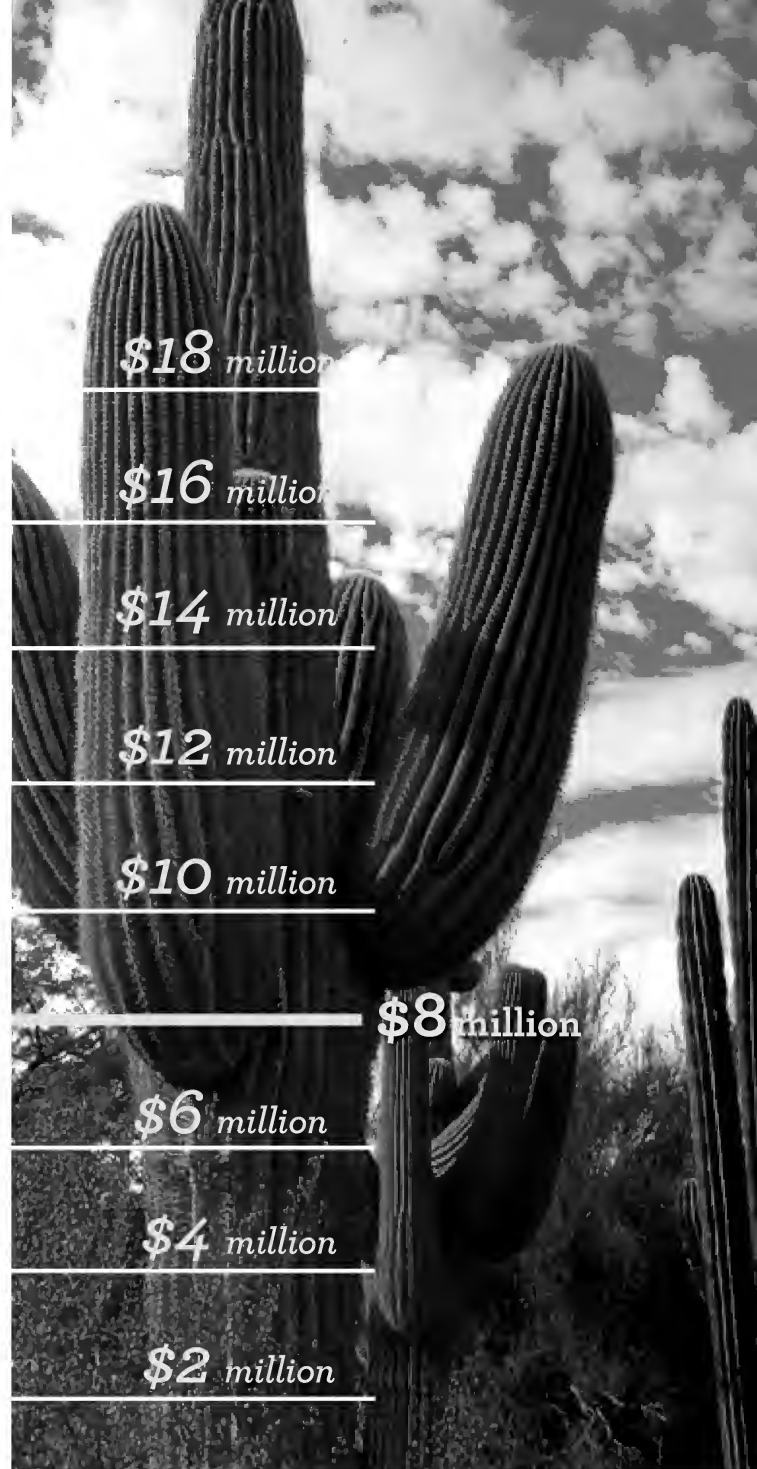
REACHING THE GOAL

This has been an exciting year for *The Saguaro Initiative*. Generous gifts have been received, including these from three local foundations:

- The Kemper and Ethel Marley Foundation made a \$1 million commitment in December 2013. We look forward to honoring their generosity by naming the future “Marley Horticulture Learning Center” in the new Horticulture Center, scheduled for completion in 2016.
- Freeport-McMoRan Foundation’s \$250,000 commitment, made in February of this year, will be recognized through the “Freeport-McMoRan Foundation Plant Salvage and Acquisition Fund,” which will support all of the exhibits developed through *The Saguaro Initiative*.
- The Steele Foundation’s latest grant of \$112,000 supports planning and development for the Community Garden Initiative. We welcome its new program coordinator, Nicolas de la Fuente, who joined the Garden’s staff this past May.



On June 12, 2014 the Garden celebrated the groundbreaking of the Desert Terrace Garden and the Jan and Tom Lewis Desert Portal with Trustee Jan Lewis and her husband Tom.



Thanks to our stellar 75th Anniversary Cabinet Members and generous supporters, \$8M has been contributed as of July 10, 2014.

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Garden's Event Plaza Comes of Age

by Marcia Flynn, Director of Event Services

Since the completion of the circular parking lot and Event Plaza in fall 2012, many of the Garden's programs have found a new home there. Collaborations with local performing arts and culture organizations in the Valley have increased the variety of offerings, too. We are pleased to share some of the more recent happenings with you.



In May 2012, prior to construction of the plaza, Ballet Arizona debuted evening performances of *Topia*, a ballet inspired by the natural beauty of the Sonoran Desert landscape, to more than 6,000 patrons over 16 nights. The following May, *Topia* returned for sold-out encore performances, again reaching close to 6,000 attendees—this time in the completed Event Plaza, where views of the Papago Buttes brought the beauty of the Ballet and Garden together.



The Event Plaza became the new location for the 2013 **Fall Plant Sale**. Its expanded layout and improved flow in the retail space created a more congenial guest experience and increased sales. Over the four-day event, the Garden saw more than 5,000 members and visitors attend the plant sale, with a Patrons Circle event kicking off the sale.



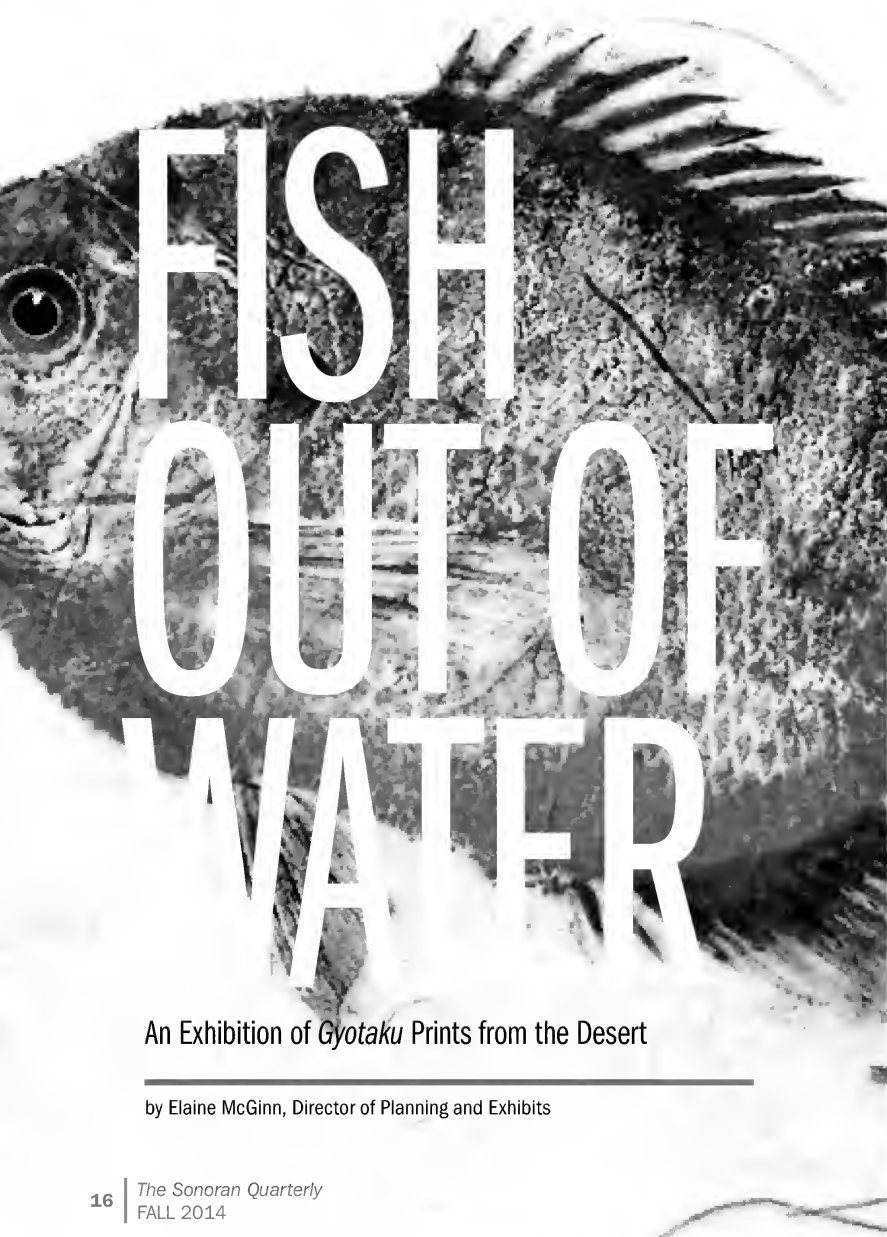
Rave reviews for the **Great Pumpkin Festival** were received from many of the 9,000 guests who attended, as the Event Plaza created a safe and expanded environment for many of the festival's activities, including pumpkin carving, carnival-style games, and children's art activities. As antique tractors transported guests to and from the pumpkin patch, they finally had a proper "stage" for displaying their inimitable charm. The free special needs day, which officially kicks off our annual Pumpkin Festival, saw its largest attendance yet with a total of 938 participants from nine agencies throughout the Valley.

The Garden's 11th annual *Día de los Muertos* Celebration rounded out the fall activities in the Event Plaza, with 3,800 members and guests attending this annual favorite. Cuisine and Culture started the programming, with the *Ofrenda* exhibition opening the same night. This was followed by a sold-out *Music in the Garden* concert featuring *Jaleo* on Friday night. The two-day festival continued through Saturday and Sunday, featuring entertainment, artists, and cuisine. *La Procepción* was the culmination, honoring those who have passed on.



In May we completed a successful 12-night run of **FairyWorlds!**, an adaptation of Shakespeare's *A Midsummer Night's Dream* produced by Southwest Shakespeare Company.

The Event Plaza has already proved in a short time what is possible for the Garden in terms of programming and collaborations. As we continue to think and dream of ways to imaginatively use the space, we are grateful for the *parking problem* that started it all!



An Exhibition of *Gyotaku* Prints from the Desert

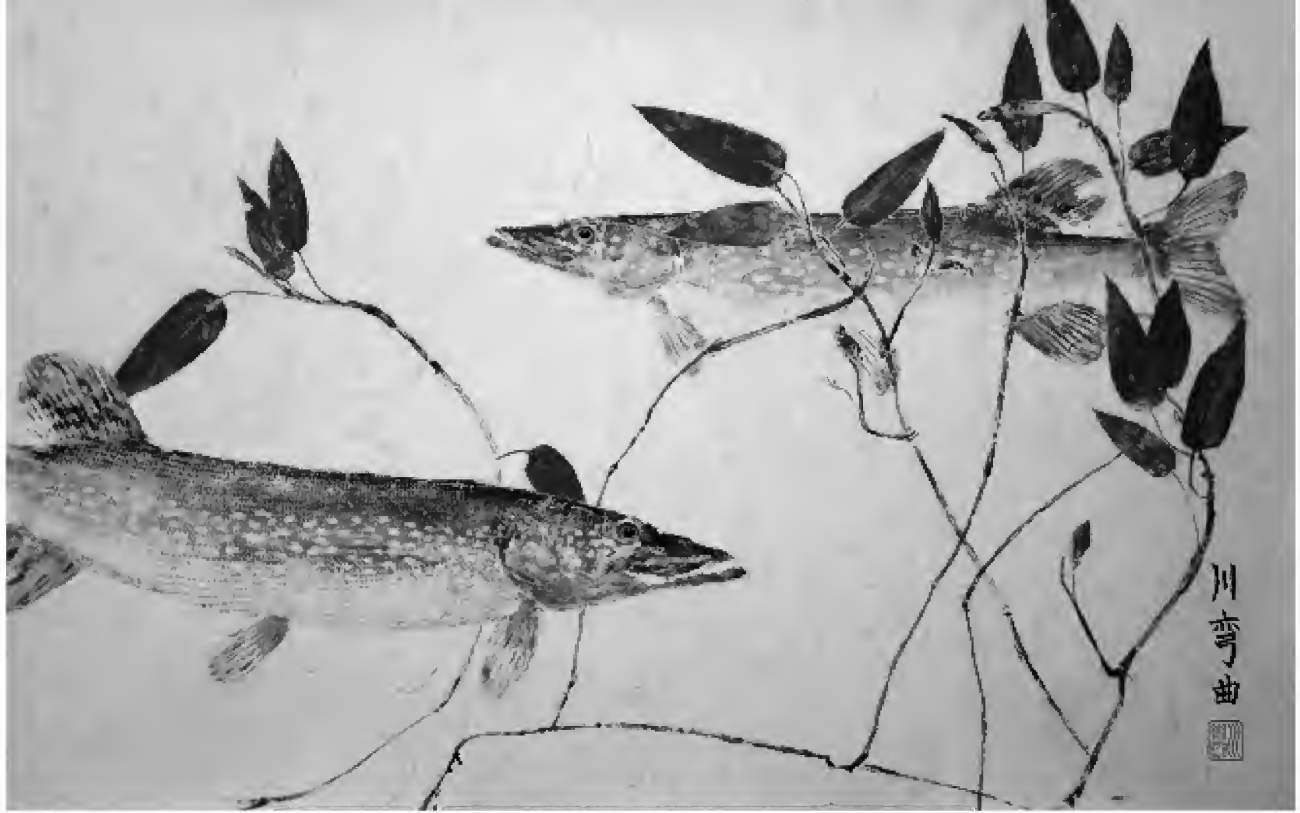
by Elaine McGinn, Director of Planning and Exhibits



Many of our readers are familiar with Dr. Joe McAuliffe, the Director of Research, Conservation and Collections. In 1990, Joe joined the Desert Botanical Garden as a research ecologist and is now recognized internationally for his research in desert plant ecology. But something you may not know about McAuliffe is that science is not his only passion. In fact, he is a gifted artist whose work, *Fish Out of Water / Gyotaku Prints from the Desert*, will be exhibited this fall in Ottosen Gallery.

Gyotaku is a Japanese word that literally means “hand-rubbed fish impression.” The art methodology involves brushing a thin coating of ink on the surface of a fish, and making an impression of the inked fish on a thin sheet of paper. The oldest known *gyotaku* date to the 1860s and were made to record the catch of a Japanese fisherman. Although they may have originally served to record the sizes and species of memorable fishing catches, *gyotaku* has since evolved into a highly prized, fine art form. It was introduced to the United States from Japan in an exhibition in 1956 at the American Museum of Natural History in New York City.

With impressions of fish from local canals, rivers, lakes and ponds, *Fish Out of Water* celebrates the water that sustains present-day societies in Arizona. Each composition is accompanied by a written narrative about natural history and conservation, and themes of inspiration and encouragement. A few even touch on the relationships of fish and human culture.



Page 16, far left: *Eternal Dance* (detail); Page 16, left: *Double Happiness* (detail); Above: *Lurking in the Weeds*, (detail).

“For me, McAuliffe says, *gyotaku* is more than simply a way of creating pictures of fish. It gives me a unique vehicle to explore many facets of the human experience – philosophy, scientific knowledge, and awareness and appreciation of the world around us. This foundation leads me to think about a story the fish can tell. *Hanashi* is a Japanese word that means narrative or story. I call my style of artwork *hanashi gyotaku* because each piece usually tells some kind of story. As a narrative unfolds in my mind, the approach to a new *gyotaku* composition also develops. As I work, the ideas for the inked composition and a written narrative build on one another, enhancing the creative process and enriching the total outcome.”

Before he began to work in desert environments, McAuliffe’s research and publications included studies of aquatic life such as fish, amphibians, turtles, and insects. “All my life I have equally enjoyed and been drawn to artistic creation and now, rather than a research pursuit of the aquatic realm, my artistic expression through *gyotaku* provides the cool, wet *yin* that balances the *yang* of my scientific investigations of hot, dry desert environments.” McAuliffe has practiced *gyotaku* since 1992.

An important milestone in McAuliffe’s development as a *gyotaku* artist was a search for and choice of a Japanese artist name. In 1999, after much study and reflection, he chose the name *Kawa Magatta* or in English, “River Winding.” “I grew up in Omaha, Nebraska next to the big Missouri River and spent so much time as a youth exploring meandering rivers. This name resonated with my diverse life experiences. Taking the name had a powerful psychological impact that helped me continue to advance and improve.”

Fish Out Of Water is sponsored by SRP.

As Director of Planning and Exhibits, Elaine McGinn is responsible for leading the exhibit and design process for all exhibits, both temporary and permanent, at the Desert Botanical Garden. In 2009, McGinn received a Virginia G. Piper Fellowship to study garden design in Italy, Spain and the United States.



McAuliffe in his studio, adding finishing touches to the piece *Four Await*.

As you can see, *gyotaku* is a very serious avocation for Dr. Joe McAuliffe. His exhibition will be on display daily from 10 a.m. to 5 p.m. in Ottosen Gallery from September 26, 2014 through January 4, 2015, and is sponsored by SRP.

garden news



Show Some Love: Schilling Library Loans Artwork to Exhibit

Enjoy botanical treasures from the Garden's Schilling Library Archives in "Summer of Love: friends, family, devotion," an exhibition at the Tempe Center for the Arts. Open since June 20, the exhibit brings together colorful, historic and contemporary artwork, illustrating various themes about love. A vibrant mix of ceramic sculptures, children's book illustrations, and paintings by local and national artists is on display.

The love of nature is exemplified in six, 18th century botanical illustrations from the Garden's Library Archives. Stunning cactus blooms by eminent artist Georg Dionysius Ehret, prickly pear and aloe by Johann Ignaz Albrecht and one beautiful but mysterious illustration of unknown origin are on exhibit. Artwork by Curator of the Herbarium Wendy Hodgson (on loan from Arizona Museum of Natural History) and photos by Garden volunteer Gene Almendinger are also featured.

The exhibit, located at the Tempe Center for the Arts Gallery, runs through September 13.

Microsoft Invests in the Garden

In August 2013, Microsoft Corporation contributed nearly \$150,000 in new software to the Garden through its "Technology for Good" program.

This donation resulted in Microsoft Office suite upgrades on more than 120 computer workstations over the past year. Having the same version of Office throughout the Garden improves our staff's ability to communicate and collaborate with each other. Additional project management, diagramming, and communications software provides us with tools needed for projects such as the construction of the *Desert Terrace Garden* and *Jan and Tom Lewis Desert Portal* this summer.

Over our 75 year history, investments in strengthening our capacity have improved our ability to reach goals effectively and efficiently. Simply put, they enable us to accomplish more. While improvements like the addition of parking spaces are easily visible to our visitors, other enhancements, like upgrades to our software, happen behind the scenes but are just as important.

Through its "Technology for Good" program, Microsoft works with nonprofits around the world to provide affordable access to the technology they need to be more efficient, effective and innovative for their important work."

The Garden thanks Microsoft Corporation for its valuable donation.



"Comprehensive, hands-on, fantastic instructors who care about what they are doing. Plus, you get to go to the Botanical Garden every week; can't beat that!"

- Matt White, President
at Caretaker Landscape
and Tree Management
Desert Landscape
School Graduate

Redesigning the Desert Landscape School

In response to our students' feedback and needs, the adult education team at the Desert Botanical Garden is piloting a new format for the Desert Landscape School. The goal is to provide comprehensive training in desert horticulture to a diverse audience of lifelong learners, adults already working in the field, and individuals seeking a career change. A modular, assessment-based format will help to reach that goal.

In its new format, each module will offer classes during weekday evenings. Participants will be able to receive training and take an assessment to obtain a certificate in any given module in two months or less. Certificate offerings will be comprehensive and will include Desert Life Forms, Desert Plant Biology, Planting and Maintenance, Sustainable Desert Landscapes, and more. The first certificate, launched this fall, is the Desert Life Forms Certificate. To learn more about this program, please visit dbg.org/landscapeschool.



***Dinner on the Desert* Raises \$400,000 for the Garden's Education and Community Programs**

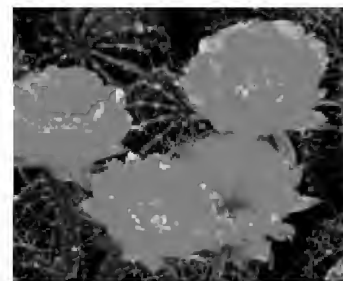
The Desert Botanical Garden hosted 610 guests at the 28th annual *Dinner on the Desert*, chaired by Martha Hunter Henderson. The event theme *Savor the Sonoran Desert* celebrated the desert's colors, shapes, and scents.

The evening began with guests arriving at *Ottosen Entry Garden* with warm welcomes, signature Blood Orange and Prickly Pear Margaritas, and music by Simply Three. Guests enjoyed the setting sun as they passed by stunning *Chihuly in the Garden* installations on their way to Dorrance Hall for the silent auction. There, they had a chance to bid on 300 striking specimen plants,

garden art, benches, fountains and exceptional experiences.

The magical setting of the Stardust Foundation Plaza, in the presence of several magnificent *Chihuly in the Garden* sculptures, provided the background for an evening of inspired cuisine prepared by Fabulous Food Fine Catering and Events.

After dinner, musical guest Porangui enticed guests back to the *Ottosen Entry Garden* for a sweet treat and a nightcap under the stars. Telescope viewing of Saturn and Mars was available courtesy of the Phoenix Astronomical Society. The Garden offered live animal encounters with a desert tortoise, spiny lizard, and leopard gecko.



To Better Serve You

Over the next year we will be making changes to some of the publications that you receive from the Garden.

Our goal is to better serve you, our members, and the Garden's mission. We will make sure that you are informed as the changes occur.

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Page 4 Garden scene - Adam Rodriguez
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Page 10 Parking lot drainage system - Einav Henenson

Page 11 El Niño & La Niña global pictures - NOAA
Page 13 Jan and Tom Lewis - Adam Rodriguez
Page 14 Topia - Rosalie O'Connor, Plant Sale - Adam Rodriguez, Patrons Circle Preview - David Schmidt Photography
Page 15 Great Pumpkin Festival - Adam Rodriguez, Día de los Muertos - Gene Almendinger, FairyWorlds - Mark Gluckman

Pages 16-17 Fish Out of Water - Joe McAullife
Page 18 Summer of Love - Tempe Center for the Arts
Page 19 Dinner on the Desert 2014 - Darrylee Cohen
Back page Fishhook barrel cactus - Adam Rodriguez, Luminaria - Adam Rodriguez

in appreciation

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The Desert Botanical Garden is grateful to all 38,158 members & donors for their support. Acknowledged in this section are annual Curator's Circle, Director's Circle, President's Circle & Founder's Circle members & donors giving \$2,500 or more over the year, from June 16, 2013 through June 15, 2014. Included are memberships & unrestricted gifts to support the Garden's annual operations, excluding Dinner on the Desert.

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The Desert Botanical Garden Mission

The Garden's commitment to the community is to advance excellence in education, research, exhibition, and conservation of desert plants of the world with emphasis on the Southwestern United States. We will ensure that the Garden is always a compelling attraction that brings to life the many wonders of the desert.



FREE WI-FI is available in five locations within the Desert Botanical Garden: the area in front of Admissions, Ottosen Entry Garden, Boppert Courtyard, the Center for Desert Living Trail, and Ullman Terrace.

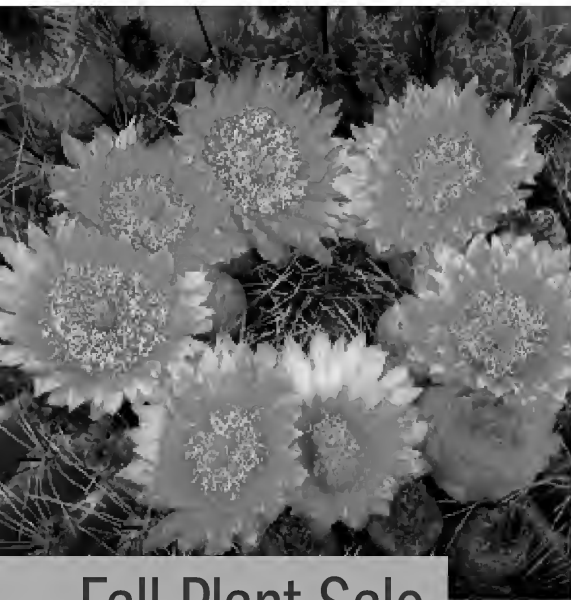
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Partial funding provided by the Phoenix Office of Arts and Culture through appropriations from the Phoenix City Council.



Fall Plant Sale

October 10 - 12

Garden Members Preview:

Friday / October 10 / 7 a.m. - 5 p.m.

Open to the General Public:

Saturday / October 11 / 7 a.m. - 5 p.m. AND

Sunday / October 12 / 9 a.m. - 5 p.m.

Your one-stop shopping experience featuring the largest variety of arid-adapted plants and expert advice from Garden horticulturists and volunteers. A large variety of specialty retailers will be there, offering unique pottery and other garden accessories.

Sponsored by: **PHOENIX HOME & GARDEN**
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Las Noches de las LUMINARIAS

DESKET BOTANICAL GARDEN

Presented by: **THE ARIZONA REPUBLIC**

The Valley's best holiday event comes to life at the Garden with more than 8,000 hand-lit luminaria bags and 10 musical groups performing nightly.

HOURS: 5:30 - 9:30 p.m.

Timed entry admission times are 5:30 or 7:30 p.m.

To create the best guest experience you may choose an admission time of 5:30 or 7:30 p.m. Limited tickets for each time period will be available.

Complete details available at dbg.org/luminaria

DATES:

Members Only: December 5 - 6

General Public:

November 28, 29, December 12, 13, 19 - 23, 26 - 30

TICKET PRICES:

Members: Adults \$25,

Children \$10 (3-12)

Children under 3 admitted free.

Tickets on sale to members September 15. Members can SAVE \$5 off adult tickets by using the discount code Lumi2014 if purchased before October 31.

General Public:

Adults \$30, Children \$12.50 (3-12)

Children under 3 admitted free.

Tickets on sale to general public September 28.

To Purchase Tickets:

- Order online at dbg.org/luminaria
- Call 480 481.8188 (8 a.m. - 5 p.m. daily)
- Visit the Admissions Box Office (8 a.m. - 8 p.m. daily)

SONORAN QUARTERLY

FOR MEMBERS AND FRIENDS OF THE DESERT BOTANICAL GARDEN

PHOENIX, ARIZONA DECEMBER 2014, VOLUME 68, NO. 4



Year-end Giving



The impact of member year-end giving could be profound, and the “strength in numbers” that our members represent could propel the Garden to new heights in 2015.



With the close of 2014 just a month away, it's time to think about year-end giving. The Garden is a not-for-profit organization with an \$11 million operating budget. Other than a \$60,000 operating grant awarded by the Phoenix Office of Arts and Culture through a competitive process last year, and another \$48,000 grant from that office this year, the Garden does not now (nor has it ever in its 75 year history) received public support for operations.

Instead, we accomplish our four-fold mission of education, exhibition, research, and conservation of desert plants by using the funds that we earn from paid admissions, special events like *Luminaria*, and from generous contributions we receive from members like you.

We now have 38,000 member households supporting the Desert Botanical Garden each year. If each member household made an extra \$10 year-end gift, a further \$380,000 would be raised for investing in the Garden's operation. If each member household made a year-end gift of \$100, an additional \$3.8 million would be generated in support of the mission in 2015 and the years beyond! As you can see, there is great strength in our membership numbers.



Of course, I would not ask for your additional support if I did not make my own year-end gift to the Garden. And it might surprise you to know that I also encourage each of our staff members to consider a year-end gift as well. (However, there is absolutely no obligation for any staff member to participate.) I am extremely proud to report that last year 93 of our staff members did make a year-end gift to the Garden and special initiatives. I anticipate a similar response from the staff this year, which speaks volumes about how important we think the Garden's mission is, and how committed we are to achieving that mission.

As I described above, the impact of member year-end giving could be profound, and the “strength in numbers” that our members represent could propel the Garden to new heights in 2015. Will you join me by making your own year-end gift to the Desert Botanical Garden? I hope so, and send my thanks in advance for your consideration of this request for support.

Wishing you and yours all the best in 2015,

Ken Schutz
The Dr. William Huizingh Executive Director

P.S. Your mail-in year-end contribution form is included on page 16 or you may make a year-end gift to the Garden online at dbg.org/donate.

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In Appreciation

On the Cover

Echinopsis species. Photo by Adam Rodriguez.

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Las Noches de las Luminarias

The Valley's best holiday event.

Members Only: December 5 - 6

General Public: November 28 - 29,

December 12 - 13, 19 - 23, 26 - 30

5:30 - 9:30 p.m.

Timed entry admission times are

5:30 or 7:30 p.m.



GIS Specialist and her volunteer equipped for another day of mapping Garden plants.
Photo by Dick Trelease.

NEW TECHNOLOGY AND OLD-FASHIONED TEAMWORK— WHAT IT TAKES TO GROW THE GARDEN

by Kimberlie McCue, Assistant Director of Research, Conservation,
& Collections and Program Director, Conservation of Threatened Species
& Habitats; and Kristen Kindl, Plant Registrar

Everyone loves to get a peek behind the scenes, to go backstage, to pull back the curtain. If you do too, get ready to come along with us on a “tour” that will give you an insider’s view of the detailed work needed to prepare for the construction of a new Garden exhibit—the *Desert Terrace Garden* and the *Jan and Tom Lewis Desert Portal*.

It Begins with Technology

Our tour begins in 2011 when the Garden's Research, Conservation and Collections (RCC) department received a grant from the Institute of Museum and Library Services to develop a completely new plant collection database, Geographic Information System (GIS), and provided funds for hiring a GIS specialist. You might wonder what a database and mapping system have to do with an on-the-ground exhibit. The answer is, a lot!

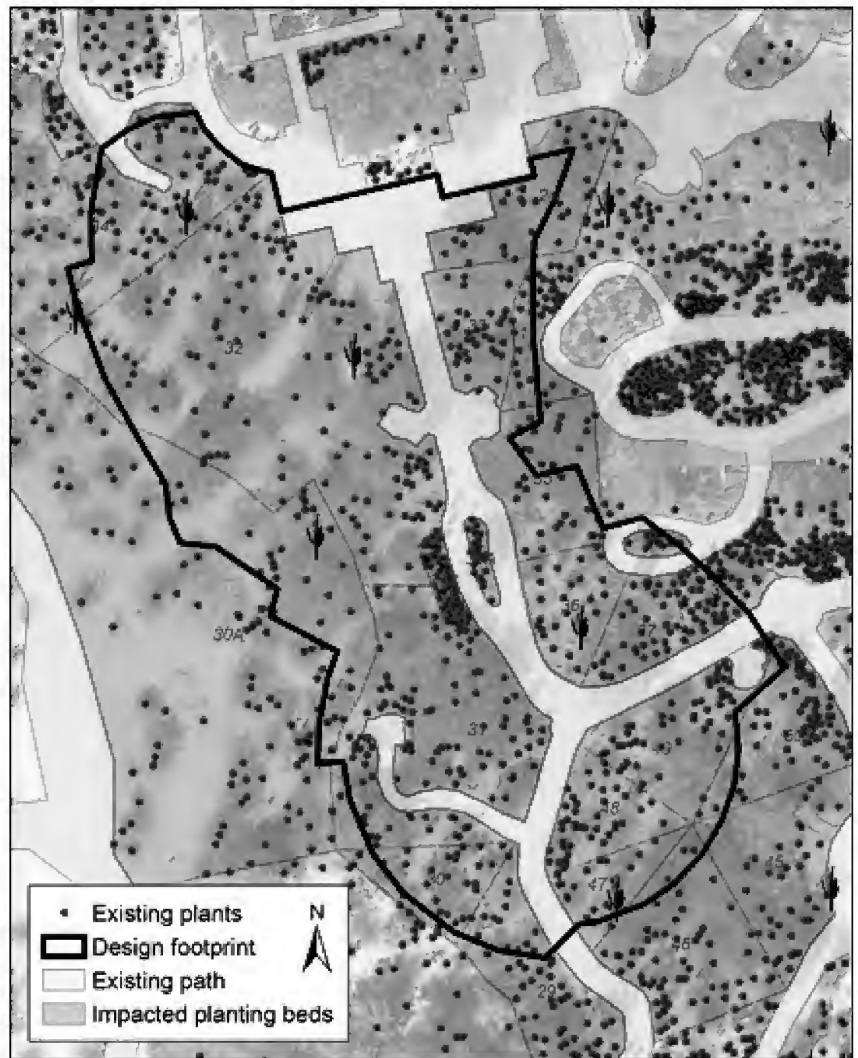
An innovative aspect of the 2011 grant project was the creation of a plant database that is cloud-based. This means that the database, which contains many pieces of scientific data, can be accessed by any device with an Internet connection, including smartphones and tablets. A significant aspect of GIS is that it allows us to link spatial data—in our case, where plants are located—with the scientific data for those plants, which includes things like the name of the plant, who collected it, and how long it has been in the Garden.

With the new database and GIS infrastructure in place, we were ready to begin collecting information. If you were a regular visitor during mid-2011 to early 2012, you may have seen a small army of staff and volunteers carrying a seven-foot-tall GPS (Global Positioning System) antenna and searching every inch of ground for plants. You might easily have wondered, "What in the world are they doing?" They were mapping every cactus and agave plant in the Garden, even those hard-to-find cacti like baby saguaros and *Mammillaria* that typically hide out under creosote bush and other nurse plants. In the end, they produced a Garden-wide database map that has a reference point for each plant in the Cactaceae and Agavaceae families; when any point is clicked on, it brings up all the scientific data associated with that plant.

Putting the Technology to Work

Now that you have the background on the technology, let's get back to the *Desert Terrace Garden* and the *Jan and Tom Lewis Desert Portal* project.

When the designers of this new exhibit submitted their first draft, we were able to use the GIS technology to overlay the design footprint onto the Garden map. By doing this we could see that plants in approximately 21 beds would be impacted by the construction of the new exhibit. However, at that time only the cactus and Agavaceae were on the map and connected to the database.



GIS overlay depicting area of project impact. Map created by Veronica Nixon.

As a living museum, the Garden's plant collection is unique in that unlike an art museum's collection, which is static with minimal movement, our collection is dynamic—it lives, multiplies, relocates and declines with time. Therefore, in order to properly manage the plantings in the terrace/portal project area, we needed to first complete an accurate inventory of all the plants within the 21 impacted beds.

The Garden's GIS specialist, Veronica Nixon, and her volunteers went to work mapping all the trees, shrubs, and other non-cactus, non-Agavaceae plants. They also verified that the cactus and Agavaceae reference points were still accurate—from the smallest Arizona fishhook (*Mammillaria grahamii*) to each individual, intertwined, aptly named octopus cactus (*Stenocereus alamosensis*). In all, 790 plantings within the beds impacted by the project were confirmed and mapped.



Preparing an *Agave salmiana* for transplant with assistance from Native Resources equipment.
Photo by Kristen Kindl.



Stretch wrap around a *Calliandra californica* allows for easier digging. Photo by Raul Puente.

To fully complete the inventory, Curator of Living Collections Raul Puente-Martinez, along with Plant Registrars Joni Ward and Kristen Kindl, followed with their volunteers, making sure every mapped plant was accessioned, meaning it was accounted for in the database and tagged with a unique accession number. An accession number is assigned to a plant when it enters into the collection, linking the plant to its respective data in the Living Collections database. A metal tag stamped with its accession number is placed with the plant and remains with it throughout its time at the Garden.

To accomplish this complex inventory in the most efficient way possible, Veronica developed an editable web map using the ArcGIS app by Esri, providing real-time access to our GIS database via iPads and iPhones. Partnered with the Living Collections database, which is available online, we were able to research or edit the plant data on the spot while out in the beds. This eliminated piles of paper and running back and forth to the office computers whenever there was a question.

Because each plant in the project area would need to be salvaged, either potted or boxed or moved immediately to another area in the Garden, we also



utilized the technology to input salvage directions for those plants that required specific instructions.

For example, cuttings were needed from some plants before they were moved. Other plants were to remain in place, some of which were later reused in the new design.

Prior to the first shovel hitting the ground, we also identified and prepared the areas throughout the Garden that would receive relocated plants. Senior staff from the Horticulture, RCC, and Exhibits departments identified appropriate sites for plants that were to be immediately transplanted. A temporary shade structure was built near the construction site to act as a holding area for plants that were to be removed and replanted into new beds within the following weeks. The back-of-house propagation area was expanded to accommodate the plants that would transplant better in the fall and for the cuttings that would be collected and grown out.

We updated the web map, with input from the general contractor, to include the construction fencing and the actual limit of work. This enabled us to narrow the area of focus and minimize the number of plants to be moved.

12 Days of Teamwork to Move Hundreds of Plants

With the new technology in hand and our game plan all set, it was time to execute the salvage operation. Unfortunately, there was not an app for that! Instead, we relied on ingenuity, physical work, and teamwork to complete the task at hand. Sixteen staff members and seventy-three volunteers from Horticulture and RCC, plus three Horticulture interns, worked together over a twelve-day period to dig up and move hundreds of plants. A local firm specializing in moving large plants, Native Resources, was also brought in during this time to box and remove sixteen large specimen plants and to relocate four saguaros (*Carnegiea gigantea*).

Organizing the salvage project was like directing a precision marching band. Everything had to happen in just the right order, with different people working on specific activities at just the right time. The salvage efforts were prioritized: first clearing the area around the plants



Stretch wrap secures a *Coryphantha* clump during relocation. Photo by Raul Puente.



Staff from Horticulture and RCC prepare an *Opuntia streptacantha* for transplant. Photo by Joni Ward.

to be boxed, then clearing areas where construction fencing was going up and by any frequently traveled pathways. Simultaneously, cuttings and plant “pups” were being collected in order to have backup material in case anything detrimental happened to the mother plant. A small piece of flagging tape was placed on the accession tags of the mother plants to indicate that cuttings had been taken and the plant was ready for salvage.

As the salvage progressed, creativity was called upon. Large established clumps of cacti (e.g. *Mammillaria*, *Coryphantha*, and *Echinocereus*) needed to be moved with minimal disruption. To accomplish that, Raul shared a technique of using five-inch rolls of stretch plastic wrap to hold the clumps together, which made for easy handling and carrying. The same technique was used on large shrubs to hold branches together and out of the way, making it easier to dig them out.

We found that using wooden pallets to move large shrubby and arborescent (tree-like) cacti, such as prickly pears (*Opuntia*), was a real help. Standard size (4ft x 4ft) pallets were placed next to cacti to be dug up, and then the plant was lowered onto the pallet. This made it easy to load plants onto carts for

transport and placement into their new locations. For arborescent plants, we used 4ft x 7ft wooden pallets with a couple of straps to hold the trunks in place.

Keeping Track of Everything

At the beginning of the salvage project, we had briefed the staff and volunteers on what was needed for record-keeping purposes: all plant material *must* have an accession number with it and a daily log was to be filled out for plants as they were being removed, including their new location. At the end of each day, the plant registrars entered the information into the Living Collections database, which in turn removed the plants from the web map.

As a progress report of sorts, it was quite the daily morale booster to see that fewer and fewer plants remained on the map and in the ground in the project area. For the plants that were immediately transplanted, a temporary map point was entered on the web map to denote the new location. Veronica used this information to follow up with the GPS to accurately map the plant. Over the weeks to follow, plants were also moved out of the holding area, planted, and mapped, with their new location

updated in the Living Collections database.

At the conclusion of the salvage project, after twelve long days of hard work, generated reports confirmed what we suspected. With the new technology, we were successful in managing and mapping the location of the collection more efficiently and accurately than ever before. Without the cooperation and collaboration of staff from departments across the Garden, this would never have been possible. Imagine the hardest, longest, most detail-oriented move a friend could ever ask you to help out with. That’s what this was!

The best part of any behind-the-scenes tour is going back to the public side of things with that special insider knowledge of what it takes to make a favorite place so compelling. We hope you will visit the Garden soon, stroll through the *Desert Terrace Garden* and the *Jan and Tom Lewis Desert Portal* and smile, partly because the new exhibit is so beautiful, but partly because now you know a little bit of what it took to bring the project to reality.

Protect Your Succulents from

FROST



by Brian Kissinger, Director of Horticulture

When we are planning new exhibits or reworking existing ones at the Garden, proper placement and protection of plants is a foremost consideration. Careful planning allows us to push the limits, especially for exhibiting succulents. Micro-climates that allow us to display them in protected locales can be duplicated at home. Appropriate placement under large evergreen trees, under eaves, against warm walls, or next to buildings can usually provide safe, protected conditions for more tender specimens.



Apart from advanced planning, there are still ways that you can protect your succulents from the dangers of freezing weather. Here are some practical tips that will help your desert plants come through the winter without serious damage.

- 1** If a freeze is in the forecast and your plants are in a vulnerable location, a frost blanket typically can provide enough protection. Do not use plastic.
- 2** Refrain from watering your succulents in advance of a freeze. Succulents typically have a better survival rate if the soil around them is kept dry.
- 3** Columnar cacti such as the organ pipe or *Cereus* are most vulnerable at the tips of the stems. The growing tips can be protected with a frost blanket or with Styrofoam™ cups. Do not leave cups on after the danger of frost is past.
- 4** Aloes typically bloom in the winter months when a freeze is most likely. Aloe plants are able to take the cold but the flowers are frost sensitive. To protect the bloom stalks without damaging or breaking them, place your frost cloth over a frame similar to a tomato cage.
- 5** Be sure to remove all frost coverings the next morning after the sun comes up and temperatures have recovered. Keep your frost cloth handy in case another event is expected.

If your plant shows signs of freeze damage, do not remove dead tissue until later in the season after the danger of frost is past.



Scott McMahon, the Garden's cactus collections manager, added that south-facing areas and patios with hardscape can also provide more radiating heat during cold nights, making suitable locations for succulents. He also recommends having a "frost kit" readily available. A storage container holding frost cloths, old sheets, and clamps for sealing them around sensitive plants will help you to mobilize speedily when frost is expected.

Winter storms typically pass through quickly, leaving nights clear and cooling off rapidly. Keep informed and up to date with your local forecast. The possibility of a frost/freeze event can occur in the lower deserts from late November through early February.

Every property has areas that offer more protection for delicate specimens. Take the time to study your garden and situate your plants well. Don't fear the freeze, prepare for it!



As Director of Horticulture, Brian Kissinger is responsible for the ongoing care of the Garden's plant collection. He is a published horticulturalist as well as a landscape designer. He writes a weekly column in The Arizona Republic

– Know Your Desert Garden. Brian holds a Bachelor of Science degree in Ornamental Horticulture.



Monarchs and Milkweeds— Conserving One of the World's Favorite Butterflies

by Kim Pegram, Exhibits Specialist for Butterflies and
Kimberlie McCue, Assistant Director of Research, Conservation & Collections
and Program Director, Conservation of Threatened Species & Habitats



The monarch butterfly—one of nature's great migratory animals and one of the world's most recognized butterflies—is in trouble. Monarchs have experienced significant declines in population numbers over the last several years, with the loss of habitat for their primary food source recognized as a significant factor.

The orange and black monarch belies its seemingly delicate nature (the average monarch weighs about the same as a paperclip) by making the long trip from the U.S. to southern Mexico each winter. Many people are aware that loss of habitat in the Mexico overwintering grounds is adversely affecting monarchs. But did you know that the loss of milkweed plants in the landscape across the U.S. is also affecting the numbers of monarchs?

The Desert Botanical Garden is taking steps to join in the monarch conservation effort by providing essential plant resources for monarch butterflies and caterpillars, providing interpretation and education about monarchs in the *Marshall Butterfly Pavilion*, and by embarking on new research projects.

Documenting the Vital Milkweed

Milkweed plants are the sole food plant for monarch caterpillars. Adult female monarchs must be able to find milkweeds in order to lay the eggs that will produce the next generation. To reverse the loss of critical milkweed habitat, monarch conservation organizations have begun to encourage planting of milkweeds by everyone from home gardeners to government agencies to nonprofits.

The Garden has long been a mini-oasis for monarchs because of the milkweed plants and other nectar sources on the grounds, which feed the adult butterflies. Recently, we began documenting just how many milkweeds the Garden has available for the monarchs. Using the Garden's GIS (Geographic Information System) capabilities, we are mapping and verifying the identification of all species of milkweed onsite. This process is still underway, but so far we have mapped more than 200 plants representing four different milkweed species. This documentation of monarch habitat enabled us to register the Garden as a Monarch Waystation. You can certify your own home garden as a Monarch Waystation, too (see sidebar page 11).

Even before recent monarch declines began making news, the Garden's *Mariposa Monarca* Monarch Butterfly Exhibit, sponsored this year by SRP with support from The Ferry Family Foundation, has highlighted the need for monarch conservation through exhibit signs, interactions between Garden staff, volunteers and visitors and, of course, with the monarchs themselves. We continued the effort this fall by expanding education opportunities through the *Monarch and Milkweed Saturday* events and new classes on monarch conservation for both families and adults.

A New Monarch Research Program

This past summer and fall, Pegram and McCue collaborated with Dustin Wolkis, research assistant, and Steve Blackwell, conservation collections manager, to develop a research program to study interactions between monarch butterflies and milkweeds. This endeavor has been exciting for all of us as it has provided an opportunity for bringing together the butterfly expertise of Kim Pegram in the Exhibits department with the plant and conservation expertise of staff in the Research, Conservation and Collections department. Together, we first explored many different questions related to the use of milkweeds by monarchs.



Asclepias subulata



Asclepias angustifolia



Asclepias curassavica

We then homed in on questions that would allow us to not only better understand the interactions between monarchs and native Sonoran Desert milkweeds, but also to better advise our visitors and community members on how best to plant for monarchs. For example, there are multiple species of native and nonnative milkweeds available for Southwest gardeners who want to create a monarch-friendly garden. But, how and what should one choose? Are some milkweed species better than others for attracting monarch butterflies and for monarch caterpillar health?

We are in a unique position to study these interactions because of our concentration of plant experts, a butterfly expert, and the *Marshall Butterfly Pavilion*. A new butterfly pavilion, planned to open at the Garden in 2017, will further expand our ability to conduct research on monarchs and other butterflies, with facilities for raising caterpillars and more area to study butterfly behavior.

This fall, we began studying three different species of milkweed. Two are native to the Sonoran Desert, desert milkweed (*Asclepias subulata*) and Arizona milkweed (*A. angustifolia*). The third, tropical milkweed (*A. curassavica*), is native to the U.S., but not to the desert. First, we began to look at which species of milkweed female monarch butterflies prefer to lay their eggs on. If they prefer one species more than others, gardeners may want to plant that species to bring the butterflies to their gardens. Then, we looked at the rate of growth of caterpillars on the three different milkweed species, documenting how many survived and how fast they grew. If they are more likely to survive and grow faster on one of the three species, we will consider encouraging gardeners in the Sonoran Desert to plant that species to grow the healthiest monarchs. We will share the results of all our experiments after the data has been examined.

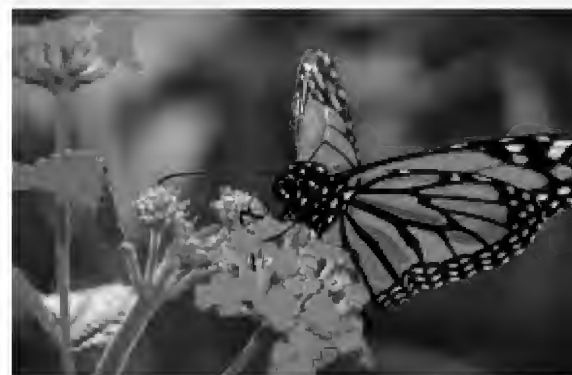
We anticipate that monarch research at the Desert Botanical Garden will have wide-reaching impacts. It will become part of the growing international body of knowledge on how monarch butterflies interact with milkweed. Monarchs migrate from Canada and the United States to Mexico, so efforts to encourage the increase of milkweed plantings in Arizona may help monarchs throughout their range.

Want to Help?

If you have a garden, we encourage you to take action to help monarch butterflies. You can create a monarch habitat by planting milkweeds and nectar plants—remembering to reduce the use of pesticides to protect the health of the monarchs and other pollinators. You can also participate in monarch tagging activities (check with the Garden in the fall for opportunities) to track migrating monarchs. By working together, we can make the fluttering of monarch butterflies in gardens throughout Phoenix an increasingly common sight.

To view videos about monarch conservation, visit our YouTube channel: [YouTube.com/DBGVision](https://www.youtube.com/DBGVision).

Building a Monarch Waystation



The Desert Botanical Garden is now certified as a Monarch Waystation by Monarch Watch, an organization created to monitor and conserve monarch butterflies. Monarch Waystations are habitats that provide resources for monarch butterflies. In order to survive and create future generations, monarch butterflies need milkweed plants, the only food source for their caterpillars, and nectar plants for the adult butterflies. You can create your own Monarch Waystation and help the monarch butterflies by planting milkweed and nectar plants in your yard and reducing the use of pesticides.

To find more information or to register your Monarch Waystation, visit the website monarchwatch.org/waystations.

GARDEN APPRECIATION

by Beverly Duzik, Director of Development

Loire Valley Landscapes

In June 2014, eighteen Patrons Circle members participated in a garden tour of Paris and the Loire Valley, visiting nine gardens in eight days. We were delighted to have professional photographer Donna Rohmer, whose work is featured on this page, with us as a guest.

Passionate stewards of these spaces, including historians, horticulturists, and chateau owners, guided the group. Dramatic uses of native stone quarried from the region, elaborate vegetable plantings that were tended in formal parterres, and pleasing water features were particularly striking elements. Not just for show, they were all designed and built centuries ago by skilled architects, engineers, and craftsmen for both aesthetic and practical purposes.

The tour showcased how respect for features in the native landscape and for the cultural history of the region came together with design principles of beauty and function to create so many significant gardens.

The next Patrons Circle tour excursion in spring 2015 will feature significant gardens in Philadelphia and the Brandywine Valley. Annual destinations in future years may include gardens in Croatia and Montenegro; Charleston, SC; southern Spain; and the Pacific Northwest.

For information about joining Patrons Circle, please contact Marcos Voss at mvoss@dbg.org or 480 481.8179.



75th ANNIVERSARY HIGHLIGHTS



Bennett and Jacquie Dorrance

Dear Garden Friend,

Calendar 2014 is coming to a close and the Garden's 75th Anniversary concludes with a review of accomplishments during this 18 month celebration. We honored the foresight and determination of Founders Gustaf Starck and Gertrude Webster, and many other individuals who helped nurture the fledgling Garden through early years of uncertainty and hardship. We celebrated the past 75 years by renewing our commitment to understanding living plant systems, to conserving threatened plants, and to reaching hundreds of thousands of citizens in the region through onsite programs and through partnerships in the community.

We launched *The Saguaro Initiative*, a multi-year fundraising effort to expand and enrich the Garden as a national center for study and appreciation of the Sonoran landscape.

We engaged a new generation of founders – individuals, families, foundations, and corporations who are underwriting a series of Garden installations, new facilities, and programs.

It is my pleasure to recognize the dedicated 75th Anniversary Cabinet volunteers for their leadership, which inspired 711 donors to support TSI to date. Thank you to Rebecca Ailes-Fine, Kate Baker, Oonagh Boppart, Lee Baumann Cohn, Mike Cohn, Jacquie Dorrance, Barton Faber, Peter Fine, Hazel Hare, Barbara Hoffnagle, Martha Hunter, Jan Lewis, Tom Lewis, Harry Papp, Rosellen C. Papp, Ken Schutz, and Archer V. Shelton.

Phase I of *The Saguaro Initiative* has concluded with \$9 million in contributions, pledges, and anticipated gifts directed to Garden projects. With more to come in a future phase, we celebrate a job well done and right on schedule! Endings are really new beginnings, new opportunities. Garden members and friends are the stewards of its future. For that, I am most encouraged and most grateful.

Sincerely,

Bennett Dorrance

Bennett Dorrance, *Chair*
75th Anniversary Cabinet

For more information about TSI projects and supporters to date, visit the website at dbg.org/thesaguaroinitiative.

The Saguaro Initiative REACHING THE GOAL



Construction and planting for the *Desert Terrace Garden* and the *Jan and Tom Lewis Desert Portal* will be completed just in time for *Luminaria*!



To develop the new Horticulture Center, dedicated teams of Garden trustees, volunteers and in-house staff professionals are collaborating with selected outside experts in architecture, design, engineering, and sustainability practices.

Literacy *through* NATURE

by Tina Wilson, Director of Education

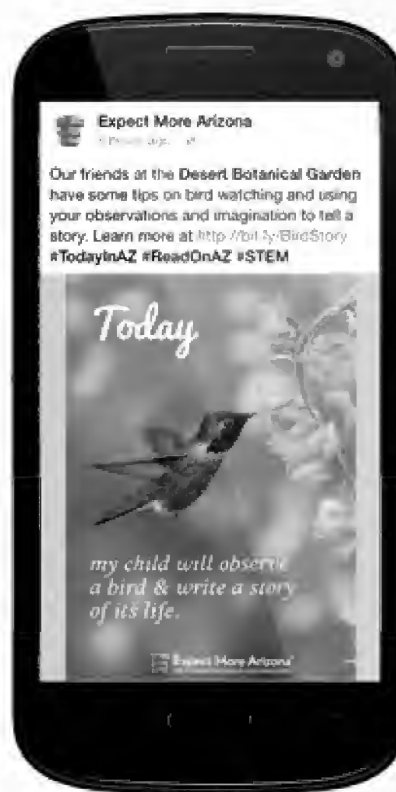
Early childhood learning is increasingly viewed as the most important predictor of later success in school. Its focus has now shifted to aligning with Pre K-3 learning standards, accountability systems, and a greater emphasis on early literacy.

Exposing children to multiple literacies and allowing them to play and improvise is the foundation to academic growth and development. Early language and literacy does not mean early reading. Rather, it involves interactions with text, symbols, context, conversation, and new experiences.

Taking effect in the 2013-2014 school year, the Move On When Reading law, enacted by the Arizona State Legislature, requires schools to retain third grade students not meeting the current state reading assessments. In all, more than 22,000 third grade students are potentially not reading at grade level (2012 AZ Third Grade AIMS Reading Scores). The latest National Assessment of Educational Progress reports that 75% of Arizona fourth graders are not proficient in reading, making Arizona's rank forty-fifth out of the 50 states.

The Garden is committed to supporting parents, caregivers, and students in the development of early childhood pre-literacy skills. As children enjoy field trips with the Sonoran Desert Adventure program, the Pre K Seedlings class, or other family activities, they are being exposed to context, conversation, and nature experiences. These building blocks lead them to other skills such as prediction, storytelling, observation, and recall, which contribute to success in school.

Parents of young children do not often think of cultural organizations as places to learn with their kids, or do not know how to experience sites with their children in a rich and meaningful way. The Garden is partnering with Expect More Arizona and other organizations like Childsplay, Phoenix



Zoo, Museum of Northern Arizona, and Children's Museum of Phoenix to create the *Early Learning Through Arts and Culture* partnership. Through this partnership, we will not only raise the profile of cultural institutions as learning destinations for families, but will build a literacy-rich culture in Arizona.

The Garden is also participating in the Expect More Arizona *Today* campaign, which promotes simple actions each of us can take every day that will lead to improved education in Arizona. Our first submission described a nature literacy action through the Desert Book Club. This activity brings authors and illustrators together with children to explore how they can use their imaginations, words, and pictures to build their pre-literacy skills while learning more about the Sonoran Desert. View more *Today* action items on the *Expect More Arizona* homepage ExpectMoreArizona.org or receive daily action items through Facebook.

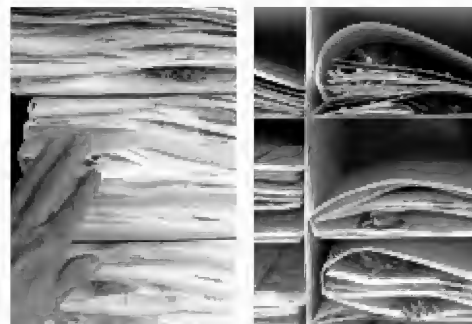
Early learning enrichment through nature activities contributes to the successful development of the whole child, resulting in a healthy, engaged, literate member of the community. Preparing children for their academic future is accomplished not only in schools and at home, but also through cultural institutions like the Desert Botanical Garden.

garden news

Garden Receives Prestigious Grant to Expand Herbarium and Improve Access to Collection

The federal Institute of Museum and Library Services (IMLS) has awarded the Garden a \$150,000 grant to expand the storage capacity of our herbarium by sixty percent and to process a significant backlog of specimens. The Garden's herbarium (DES), a collection of dried, pressed plant specimens, focuses solely on arid and semi-arid plants of the world with emphasis on plants of the southwest U.S. It was designated as a National Resource Collection in 1974. Grant funds will support installation of a new compactor system and addition of 60 new full-size cabinets.

The IMLS grant application and review process is highly competitive. Desert Botanical Garden's proposal was one of only 196 projects funded out of 554 applications submitted from around the country.



Grant supports going from this...to this



New Lights Illuminate Garden



The Garden is shining bright with all new LED (light-emitting diode) lighting throughout the grounds and in many of the interior spaces of buildings.

As part of our commitment to sustainability, we teamed with energy-efficient lighting solutions company Relumination to replace nearly 1,500 incandescent, halogen, and HID (high-intensity discharge) lamps with the more efficient LEDs.

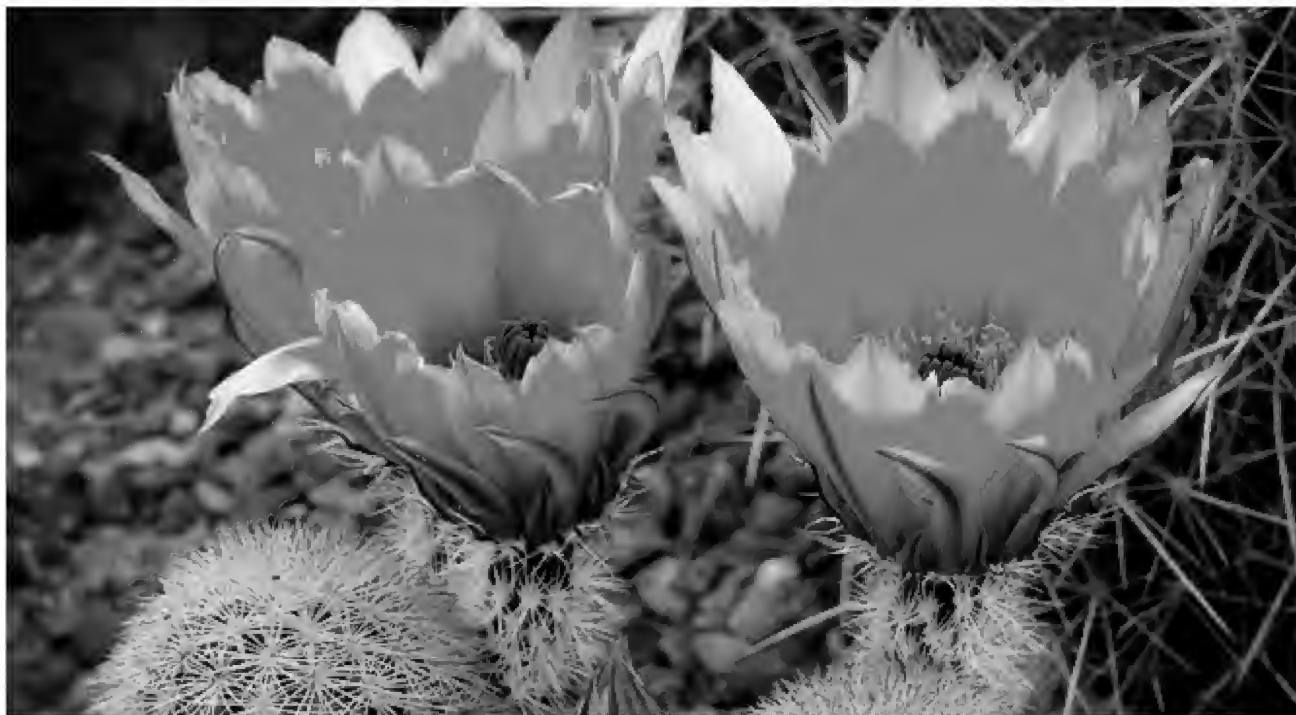
Relumination began work in May to change out all parking lot lights and building lights. Garden staff picked up the work in summer, changing landscape lights (yes, we changed outdoor light bulbs in the summer heat!). Electricity usage is projected to be reduced by more than 247,000 kWh per year and save \$30,000 annually in electricity costs as a result of the switch.

The project was funded through *The Saguaro Initiative*, with approximately 20% of the cost covered by an SRP rebate.



Desert Botanical Garden Represented at the Workshop of the Americas in Mexico

Raul Puente-Martinez, curator of living collections and Rosa Crespo, propagator, attended the Workshop of the Americas in Puerto Vallarta, Mexico on July 22 - 23, 2014. The event was organized by the Sentinel Plant Network (a program of the American Public Gardens Association) and the United States Department of Agriculture (USDA). It brought together 40 attendees representing botanical gardens in the USA and Mexico. The goal of the workshop was to start a network among gardens of each country to share information about plant pests and to prevent introduction of pests through the exchange of plant material. USDA entomologists and plant pathologists gave talks on common pests and diseases and led walks through the collections at the Vallarta Botanical Gardens showing damage to plants and identifying insects. During the event, garden staff from both countries shared information and made plans for future collaborations and plant material exchange.



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Page 11 Milkweed photos - Steve Blackwell
Top to bottom - *Asclepias subulata*

Page 11 *Asclepias angustifolia*, *Asclepias curassavica*
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Page 16 *Echinocereus dasyacanthus* - Adam Rodriguez
Page 19 *Aloe pseudorubrovittata*, Arabian Aloe - Adam Rodriguez
Back Cover *Las Noches de las Luminarias* photos - Adam Rodriguez
Correction: The cover photo for the June 2014, Volume 68, No. 2 issue was incorrectly labeled. The photo credit goes to Cindy McDaniel

in appreciation

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DATES

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December 5 - 6

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December 12 - 13
December 19 - 23
December 26 - 30

TICKET PRICES

Members: Adults \$25
Children \$10 (3-12)
Children under 3 admitted free.

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Adults \$30, Children \$12.50 (3-12)
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To Purchase Tickets:

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